Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
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FINISHING

JUNE 28, 1948
VOLUME 37, No. 13

AMERICAN DYESTUFF REPORTER

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

A new Solophenyl Color

Geigy announces the addition of a new and most interesting Solophenyl* dyestuff

*Solophenyl Dark Green G B L***

whose self-shade is most desirable and whose use as a shading element on Cotton or Rayon gives a wider application to the Solophenyl series.

Solophenyl Dark Green G B L besides offering the extreme in light fastness, characteristic of the Solophenyl series, is influenced in the minimum by anti-crease finishes. Those mills producing mixed upholstery fabrics will also like its lack of affinity for the wool fibre.

Other desirable features include its fastness to perspiration, water, salt water, dry and wet cleaning.

Bulletin #9 G gives the complete story of this new and most interesting Solophenyl Dark Green G B L.

*Registered U. S. Patent Office.
**Patented.

GEIGY COMPANY, INC.

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Dyestuff Makers Since 1859

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IN A WIDE VARIETY OF TEXTILES...

PARAMUL 115

WATER REPELLENT

PARAMUL® 115 Water Repellent, – another important development of Cyanamid Research for the textile industry – has a double purpose in life: to provide a better water repellency and a superior resistance to water borne stain. And how *well* it does *both* is proved many times a day in a wide variety of fabrics – cottons, rayons, linens and woolens – for outerwear and equipment purposes.

An aqueous solution of wax and aluminum salts, PARAMUL 115 Water Repellent saves time and money in application, is easy to use, odorless and harmless to skin and fabric. It provides complete stability over a wide range of temperatures and can be safely stored for a long time.

Profit by Cyanamid's extensive research facilities by specifying PARAMUL 115 Water Repellent for your fabrics. Take advantage of Cyanamid's expert technical staff to achieve the most superior results *possible* in water repellency and stain resistance.

AMONG CYANAMID PRODUCTS FOR THE TEXTILE INDUSTRY ARE:

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American Cyanamid Company

Industrial Chemicals Division

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

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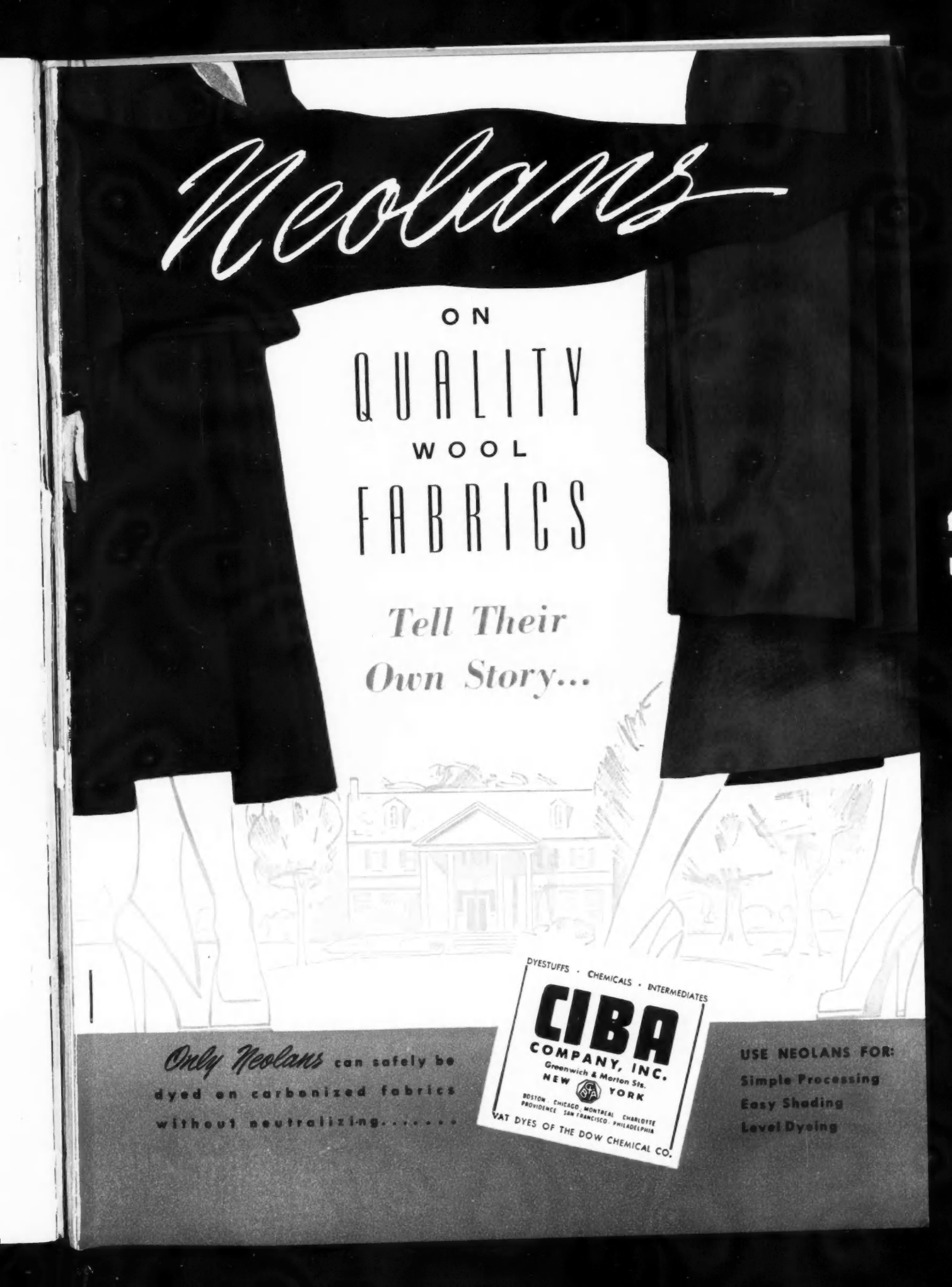
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Only Neolans can safely be dyed on carbonized fabrics without neutralizing.....
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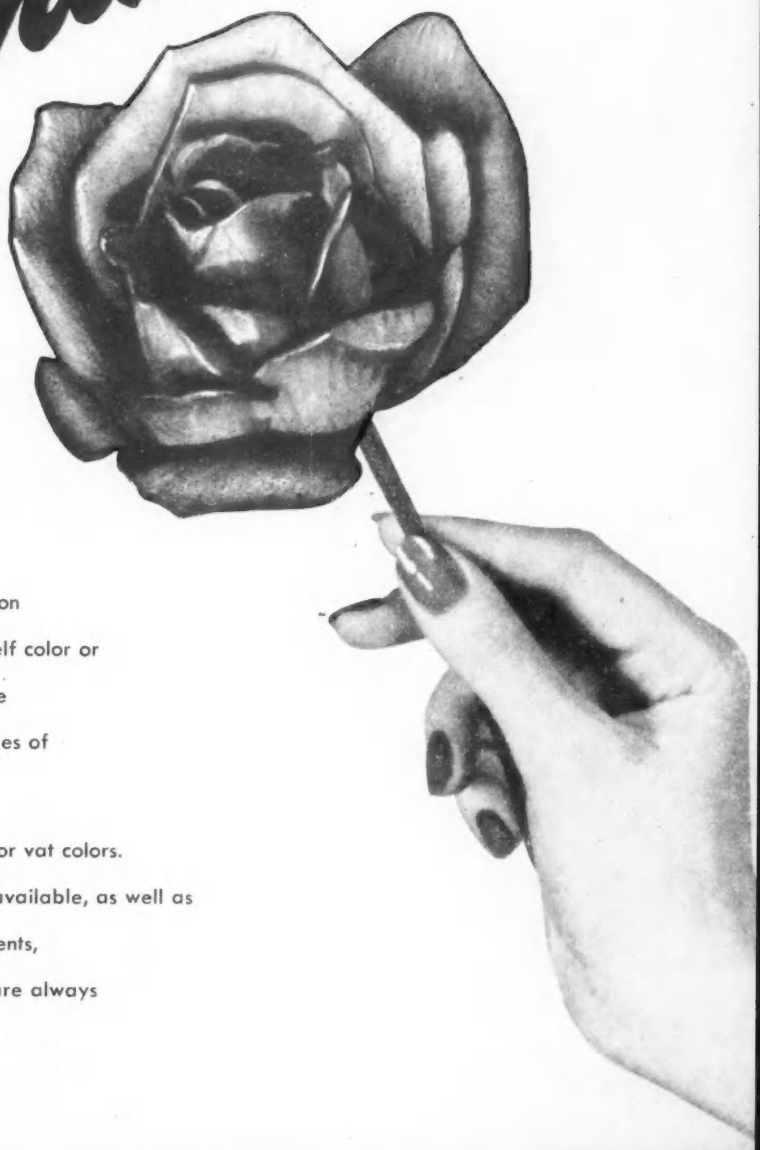
AMANTHRENE* VAT COLORS
provide the answer to the demand for
better color fastness in textiles

Amanthrene

PINK FF

in paste and
double powder form



A vat pink of distinction.
Its delicate brilliant shade tone is that
of fastidious ARISTOCRACY.

Without a peer for the printing of fine cotton
and rayon dress goods and draperies as a self color or
in combination. Equally suitable for dyeing the
same fibres. Offering the particular advantages of
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Another of the Amanthrene range of superior vat colors.
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AN EXCELLENT DYE LEVELLING AGENT

A SUPERIOR PENETRANT IN PACKAGE DYEING

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POWERFUL SURFACE TENSION DEPRESSANT

RENDERS THE FABRIC HIGHLY ABSORBENT

AN OUTSTANDING WETTING AGENT

Hartex Duofol L, a sulfated condensation product, is a clear amber oil possessing superior wetting, rewetting, and softening properties. It is clearly miscible with water in all proportions and retains its high surface activity in the presence of hard water, salt, alkali, or weak acids.

Duofol L was developed for instantaneous wetting in baths at all temperatures up to the boil.

It is recommended for dyeing operations in general and specifically for vat and package dyeing to give greater uniformity of shade.

When a solution of Duofol L is dried into a fabric, it renders the fabric highly absorbent (rewetting property). In addition, Duofol L acts as a softening agent making its use doubly advisable in sanforizing operations.

Quantities as low as 4 oz. per 100 gallons have proved satisfactory for most applications.

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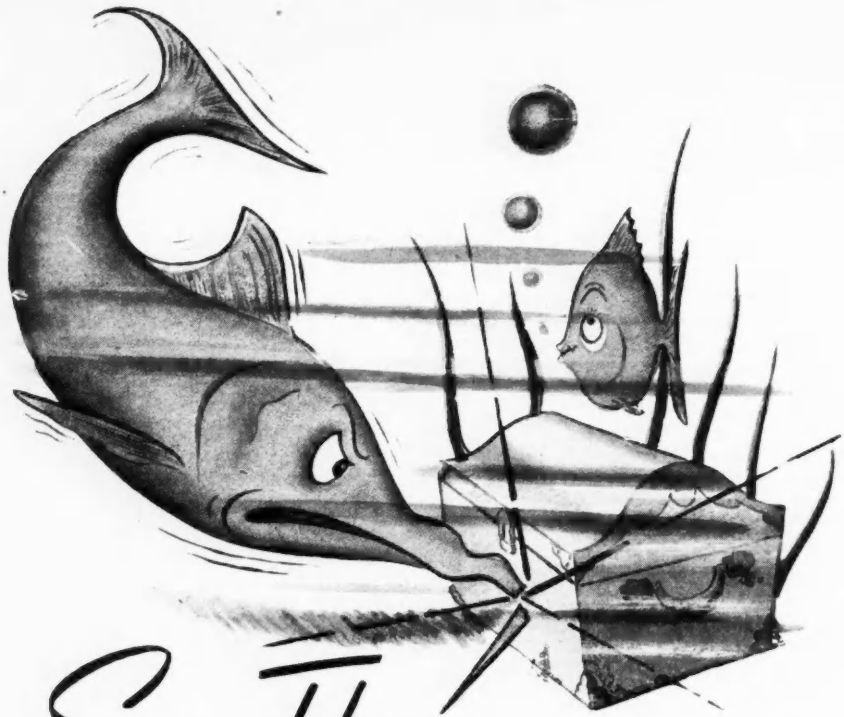

Some Things Just Don't Penetrate

BUT . . .

ATCOPEN 2-T DOES EVERY TIME!

USE IT for wetting out and rewetting on all types of fabrics!

OUTSTANDING as a carbonizing penetrant or for use in neutral wetting operations.

ATCOpenetrate with ATCOPEN 2-T

Ask for ATCOPEN 2-T product sample and full information today!

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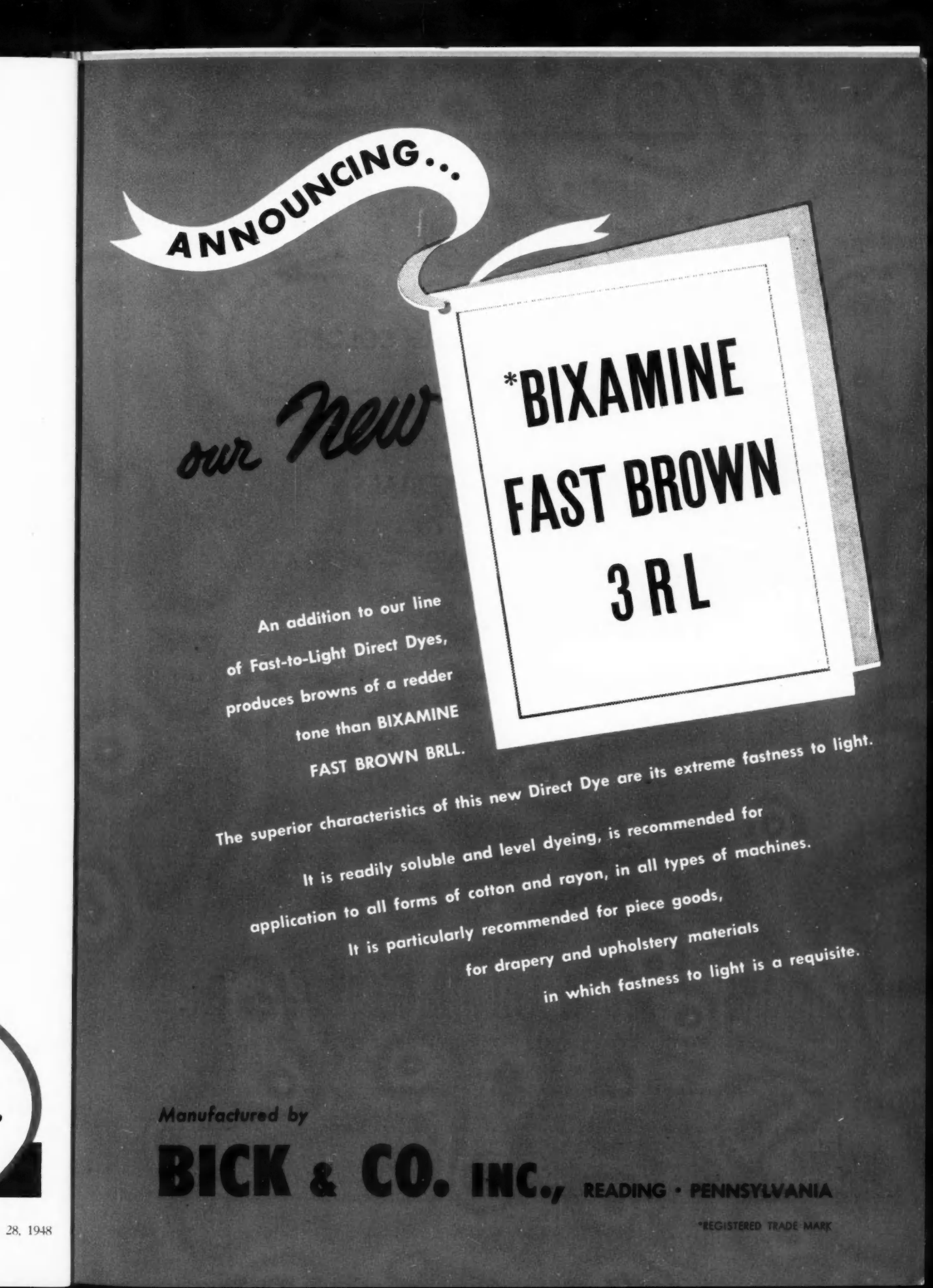
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produces browns of a redder
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The superior characteristics of this new Direct Dye are its extreme fastness to light.
It is readily soluble and level dyeing, is recommended for
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FOR

WOOL—COTTON—RAYON—ACETATE
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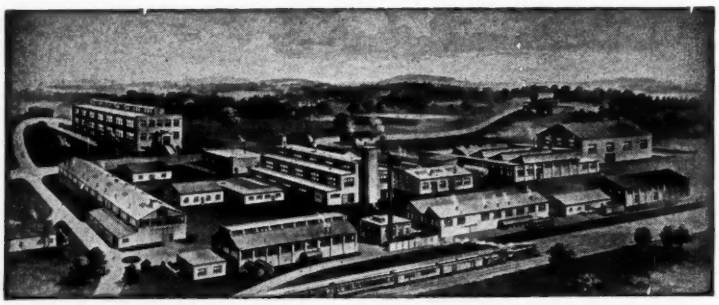

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A Great New Symbol is Rising

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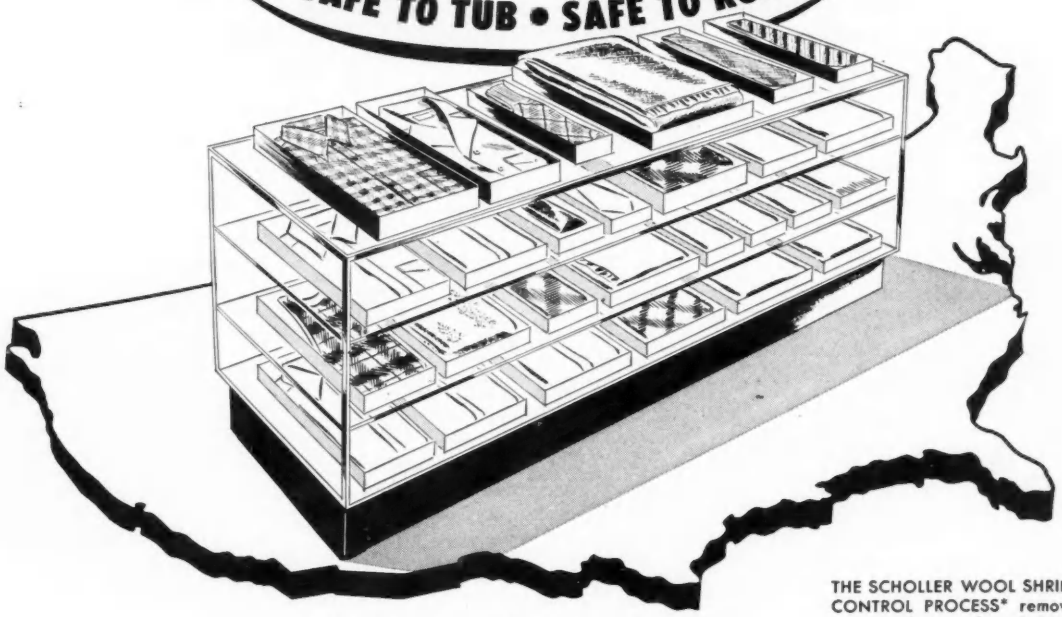
Schollerized
WASHABLE WOOL
SAFE TO TUB • SAFE TO RUB



This label assures wool a great new attribute—honest-to-goodness *washability!* Wool can now be tubbed and rubbed and never shrink . . . never mat . . . wool that will retain its original natural qualities of elasticity, resiliency, softness, texture and "hand" . . . wool whose size and colors are wash-fast for the life of the fabric.

Yes, this new insignia heralds the dawn of a great new day in the Woolen Industry—and the 146,000,000 Americans for whom wool plays an important role in their everyday American way of life.

THE SCHOLLER WOOL SHRINKAGE CONTROL PROCESS* removes the causative factors of wool shrinkage—matting and felting. Extremely flexible in application, wool may be SCHOLLERIZED in the raw stock, tops, skeins, packages or fabric.

If your product is wool, write for more details of this fascinating story on the Scholler Wool Shrinkage Control Process.

*Patent Pending

SCHOLLER BROTHERS, INC.

Manufacturers of Scouring, Dyeing and Finishing Materials

COLLINS at WESTMORELAND, PHILADELPHIA 34, PA.

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SERVING THE TEXTILE INDUSTRY FOR MORE THAN 40 YEARS

S/V Textile Finishing Oils A and B, Penetrate Uniformly into the Cloth

● No need to look any further for the right finishing oils to prepare your cloth for shrinking to the "Sanforized" standard!

S/V Textile Finishing Oils A and B, have proved their superiority in such fabrics as twills, drills and denim, as well as in the lighter materials.

The reason: These oils form stable emulsions that penetrate uniformly throughout the cloth so that the cloth uniformly and quickly absorbs moisture as it passes through the conditioning units of the Sanforizing unit. S/V Textile Finishing Oil B is especially recommended for incorporation in starch mixtures when the cloth is to be Sanforized.

S/V Textile Finishing Oils A and B, are highly resistant to oxidation and discoloration. They are permanently free from objectionable odors. Ask your Socony-Vacuum Representative for advice about applications.

Better, Lower-Cost PROCESSING for ALL Textiles

WOOLENS
S/V Woolrex Oils

Improve carding and spinning. Scour out easily.

★

WORSTEDS
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Lubricate stock uniformly, improve spinning.

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WATER REPELLENTS
Special S/V Products

Give inexpensive water repellency.

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FINISHING
S/V Finishing Oils

Plasticize starch mixtures.

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PRE-SHRINKING PROCESS
S/V Finishing Oils

Insure quick, uniform re-wetting during shrinking processes.

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RAYON PROCESSING
S/V Rayon Oils

Lubricate, soften and deluster rayon fibers.

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CORDAGE
Special Oils, Waxes

Provide waterproofing, lubrication and softening.

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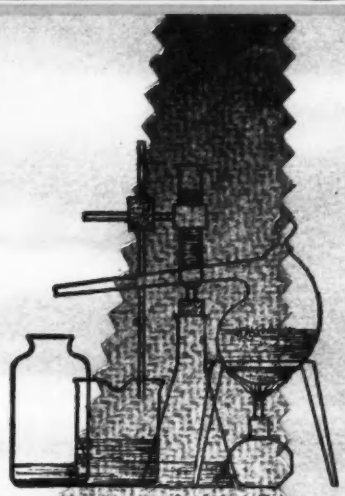

a **NEW** development applicable to all fabrics

REPCOLENE K-50

REPCOLENE K-50 has a wide field of application as a penetrating—scouring—wetting—leveling, dispersing and finishing agent

STABLE IN HARD WATER—COMPATIBLE WITH SOAP

REPCOLENE K-50 has great softening action on animal and vegetable fibres.

REPCOLENE K-50 is economical as it greatly reduces the amount of finishing compound required in scouring and dyeing operations.

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CARBIC COLOR & CHEMICAL CO., INC., 48 Pine St., Providence, R. I.

California Representative: SIDNEY SPRINGER, 2300 S. Vermont Ave., Los Angeles 7, California

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Do you have a Snagging wife?...

...as a lot of customers who feed your hosiery must withstand the "bramble patch" test? Though complete hosiery snag-proofing is an impossibility, snag-resistance is a good-will producing actuality. Fancourt Chemists have developed formulas that improve the wearing qualities of all types of hosiery including fine denier Mono-Filament. A Fancourt field man will be glad to show you what the latest developments of Fancourt Laboratories can do to help you in improving your production.

JOAN STANTON

The young lady who is not enjoying her snagged hose in this picture, says, "Though I'm not a nagging wife . . . not even a wife, in fact . . . snagged hose is a fast starter toward my boiling point. No wonder I continue to buy hose that seem to resist snags."

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In the South, Howard A. Virkler, Greensboro, N. C.

Solving Finishing Problems Since 1904

general dyestuff corporation

despite the effects of a war-time economy and the scarcity of construction materials, equipment and raw materials, the general dyestuff corporation delivered to the american consumer more than twice as many pounds of dyestuff in 1947 as before the war.

astman cetate yestuffs

Produced for synthetic fabrics, Eastman Acetate Dyestuffs are available in a variety of colors for practically every method of dyeing and printing. There are dyes well adapted to discharge or application printing. Other Eastman Acetate Dyestuffs can be used on both jig and box, at either high or low temperatures, with excellent build-up and leveling properties. Fabric dyers may take advantage of the special fastness properties of Eastman dyes developed to withstand fading under various conditions. The full benefit of Eastman research on dyeing problems is extended without obligation to users of these dyestuffs.

astman Acetate Dyestuffs are sold in the United States through Tennessee Eastman Corporation in Kingsport, Tennessee, and Lodi, N. J.; in Canada, through Clough Dyestuff Company, Ltd., 33 St. Mathieu Street, St. Laurent, Quebec.

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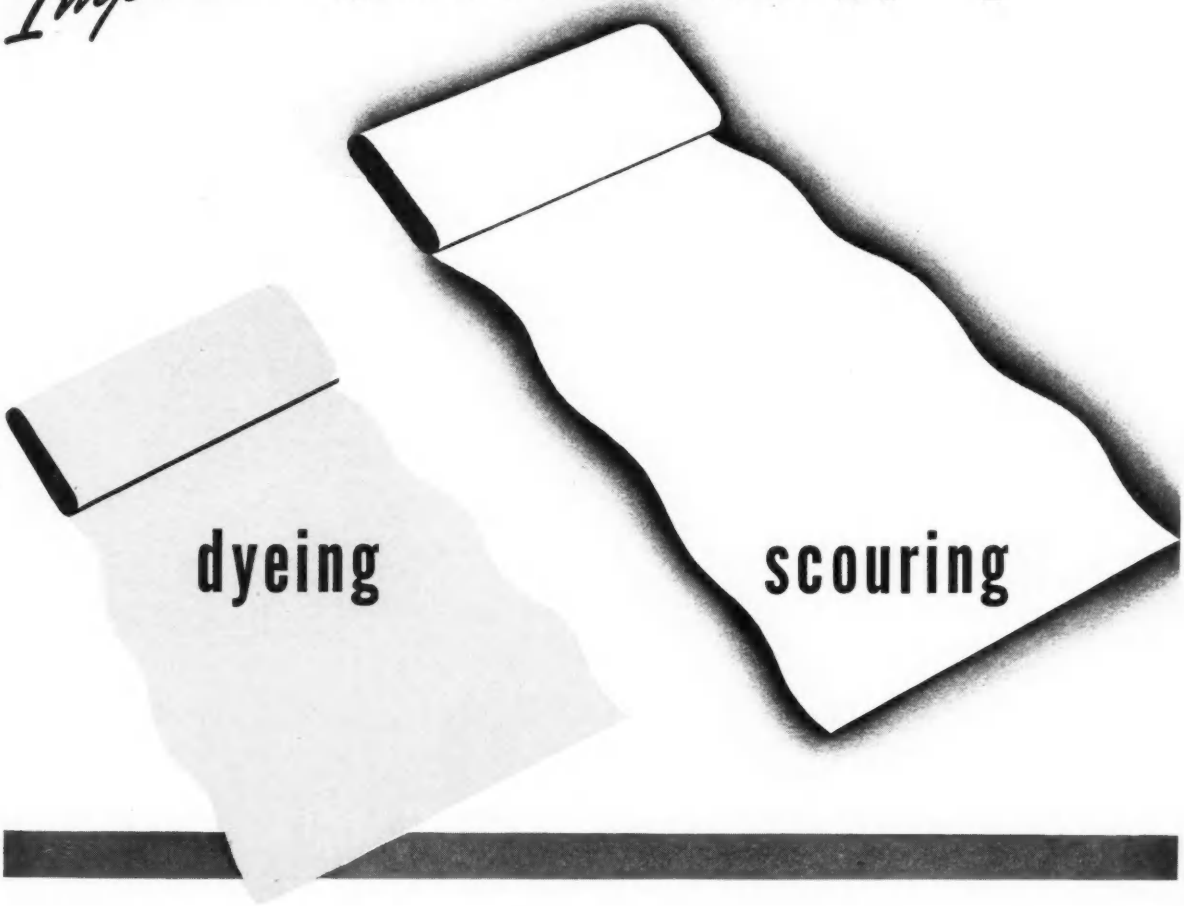
—A SUBSIDIARY OF EASTMAN KODAK COMPANY

Improved SANTOMERSE No. 1



Improved Santomerse No. 1 is the *economical* detergent and wetting agent for use in textile operations. Not only does Santomerse No. 1 combine thorough penetration, wetting out and scouring properties, but it performs *all three* functions efficiently *at low concentrations.*

Santomerse No. 1 has valuable applications at many points in the dyeing and scouring of cotton, linen, wool, rayon, silk and nylon.

For detailed information on profitable uses of Santomerse No. 1 in the textile industry, write for a copy of Monsanto Application Data Bulletin No. P-118... or ask for it on the handy coupon. MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700 South Second Street, St. Louis 4, Missouri. *Santomerse: Reg. U. S. Pat. Off.*

DISTRICT SALES OFFICES: New York, Philadelphia, Chicago, Boston, Detroit, Cleveland, Cincinnati, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle, Portland. In Canada: Monsanto (Canada) Limited, Montreal.

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She doesn't know the half of it!

ETERNALURE

RESIN FINISH FOR NYLONS

She wears better looking nylons, with a tighter, better clarified stitch. They are more resistant to snagging. These effects last for the life of the hose, because the finish is Eternalure—not that *she* cares. All she knows is that she likes the hose she wears, and buys the hose she likes!

That is good for the hosiery buyer and manufacturer, but it pays to think a bit about what Eternalure can do to save time and money in the finishing operation.

Treated nylons are handled with a minimum of pull threads. Even on the sheerest hose the Eternalure body insures easier, safer handling after boarding. But you do not have to worry about hose sticking to the forms . . . nor do the forms accumulate deposits.

No curing is required, nor any change in equipment or process. You just shift to a lasting finish with superior "buy appeal."

We are ready at any time to work with you on a full scale plant test to prove what Eternalure can do for YOUR nylons.

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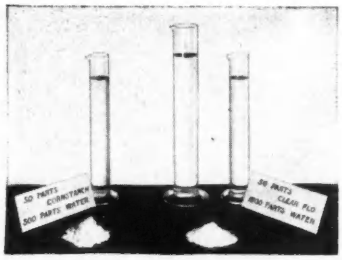
onyx RESIN FINISHES FOR HOSIERY

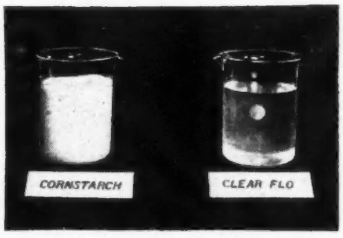
June 28, 1

NEW! CLEAR FLO

STARCHES 'H' (High Viscosity) and 'L' (Low Viscosity)



HIGH VISCOSITY. CLEAR FLO 'H' starch takes three times as much water as ordinary corn starch to give comparable viscosities.



CLARITY. CLEAR FLO starches are practically transparent while ordinary corn starch assumes a milky white opaqueness.

STABILITY. CLEAR FLO starches still pour readily from the beaker seventy-two hours after being cooked while ordinary corn starch has firmly jelled.

CLEAR FLO starch is the sodium salt of an ungelatinized, low substituted starch acid-ester derivative containing carboxylic and sulphonic acid groups. The great hydrating capacity of these groups results in starches with unique properties not found in ordinary starches plus the characteristics of some of the natural gums. Gelatinization of CLEAR FLO starches takes place with extreme sharpness and at considerably lower temperatures than with ordinary starches.

SWELLING TEMPERATURES AND RATES OF SWELLING. Taking the temperatures at which a 25% aqueous suspension of starch begins to show a measurable increase in viscosity as the gelatinization temperature, the figures below show the relatively low gelatinization temperatures of CLEAR FLO starches in comparison with ordinary starches.

CLEAR FLO 'H'	113 — 129°F
CLEAR FLO 'L'	113 — 129°F
Corn Starch	149 — 151°F
Tapioca	143 — 145°F

When cooked in a boiling bath, the gelatinization of CLEAR FLO starches takes place very sharply with the peak viscosity being reached almost immediately after the swelling of the starch begins. As with other starches, the temperature at which the viscosity increase is noted varies with the concentration, rate of heating and type of agitation.

SOLUTION VISCOSITIES

	% Concentration of Dry Starch	Solution Viscosity in Centipoises after 15' at 92° C
CLEAR FLO 'H'	2	420 Approx.
CLEAR FLO 'L'	10	440 "
Corn Starch	5	460 "
Tapioca	4	510 "

POSSIBLE APPLICATIONS. We're ready to match our research and laboratory efforts with yours in further exploration of CLEAR FLO starches in Laundry Starches, Desensitizing gums in Lithography, Cosmetics, Paper Sizing, Boiler Feed Water Compounds to Prevent Scale Formation, Dispersion of Pigments for Wet Grinding, Textile Finishing and Sizing, Low Temperature Swelling Binder for Wall Board, Gypsum, Doll Heads, Asbestos, Briquettes, etc., Cleaning Compounds, Water Colors and Paints, Wall Paper and Poster Pastes.

Address: National Starch Products, Research and Development Laboratories, 270 Madison Avenue, New York City. Plants: Dunellen, N. J., Chicago, Indianapolis and San Francisco. In Canada: Meredith, Simmons & Co., Ltd., Toronto and Montreal. In Holland: Nationale Zetmeelindustrie, N.V. Veendam.

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STARCHES — AND SPECIALTIES WITH EASILY DEMONSTRATED SUPERIORITY

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The Name to Remember When Buying Stripping Agents

Outselling all others since its origin twenty years ago — it is *today* the woolen industry's *safe* stripper. Our constant efforts to eliminate free zinc in *liquid* HYDRALDEHYDE through modern manufacturing methods assure stronger fibres in reworked wool and piece goods.

Test *liquid* HYDRALDEHYDE against any other stripping agent offered — either powder or liquid — for a true comparison of the fibre's breaking strength.

WATSON-PARK COMPANY

261 FRANKLIN STREET BOSTON, MASS.

FACTORY · LOWELL JUNCTION · MASS.

The dependable, rapid and economical de-sizing agent for cottons, rayons and mixed goods. Applicable over a wide range of processes, temperatures and speeds.

HAS PROVED PARTICULARLY SUITABLE FOR CONTINUOUS DE-SIZING

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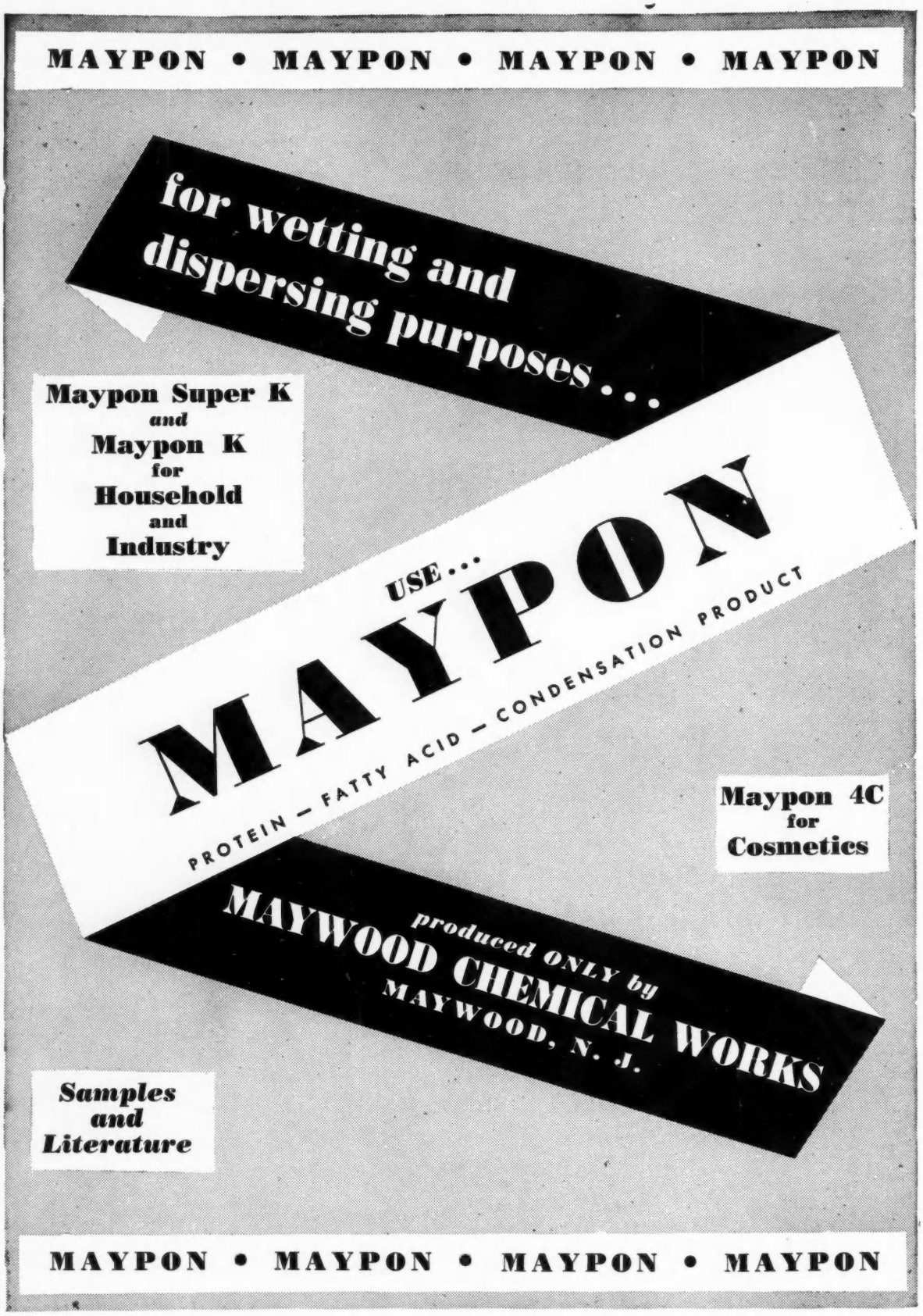
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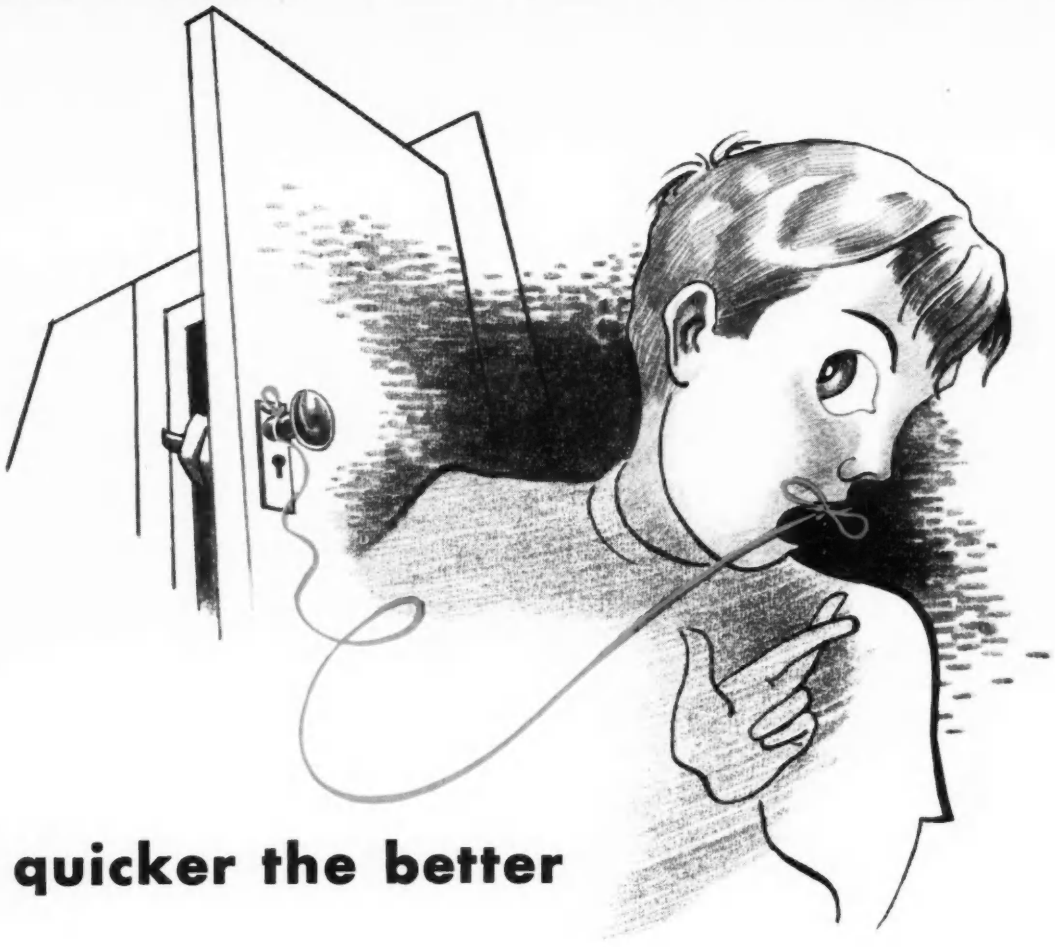

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THE QUICKER YOU PROCESS – THE BETTER YOUR WOOLENS

NACCONOL* NR

AMERICA'S LEADING SYNTHETIC DETERGENT

SCOURS FASTER

NATIONAL QUALITY

COSTS LESS THAN SOAP

DOES MORE THAN SOAP

Additional production now available. Inquiries invited.

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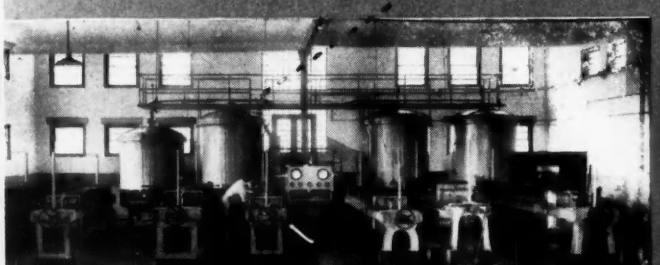

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VOLUME 37 JUNE 28, 1948 NUMBER 13

A Study of Fluorescent Dyes

HENRY E. MILLSON and E. I. STEARNS

Calco Chemical Division, American Cyanamid Company, Bound Brook, N. J.

Introduction

THE practical usefulness of fluorescent organic dyes has greatly increased in importance during the past few years. The use of luminescent materials for war purposes introduced this phenomenon to large numbers of people who might not otherwise have become aware of it. The intense interest thus aroused has been apparent in the large number of requests for information about the properties of fluorescent dyes in their various applications. The true value of these dyes lies in their application to problems which cannot be solved by the use of non-fluorescent materials. In order to answer these inquiries and to explain how to obtain a maximum of value from such dyes, it is necessary to have reliable data on their properties and limitations. This study was undertaken to provide certain pertinent data which have not, up to this time, been available.

Previous studies *(1)* have shown that many dyes have fluorescence when they are applied to different types of textile fibers. Organic dyes carefully selected from these studies and applied to textile fibers or incorporated into lacquers produce the most brilliantly fluorescent shades known. With most of these dyes, however, the fluorescence is comparatively dull and while they may be of theoretical or academic interest, they are of little if any practical value for textile and related uses. Dyes having a maximum of fluorescence are usually members of the basic, acetate, direct, or acid groups with a very limited color range. Most of these are yellows or reds, and therefore combinations of two or more fluorescent and other dyes are often used to produce a given shade. The blending together of fluorescent and ordinary dyes often gives rise to disappointing results because of the quenching effect produced by the latter.

Common Uses

Large quantities of these dyes were manufactured during World War II. Tons of Calco Uranine were used for sea markers, because of the extreme brilliance of its daylight fluorescence. Many rescued airmen owe their lives to this unique property of Uranine. Fluorescent acetate, acid, and basic types were dyed on acetate fabrics to produce a maximum of daylight brilliance for signal panels and flags. Planes were landed on aircraft carriers at night by signal officers whose flags and clothing glowed when they were activated by invisible ultraviolet rays.

Many peace-time uses have also been developed for these dyes. The fluorescent carpets used in modern theaters and night clubs illustrate both their beauty and safety qualities. These carpets, when activated by ultraviolet light, luminesce in total darkness. Thus, the dye molecule becomes a transformer and changes radiant energy to longer, visible rays. This property of certain dyes in fluorescent carpets is especially valuable for use in theaters because the patron literally walks on a pathway of light. Such glowing carpets not only guide him down the aisle, but also outline the edges, so that the danger of tripping and stumbling in the darkness of the average theater is reduced to a minimum.

Fluorescent seat coverings can also be prepared by using dyes which will glow when exposed to ultraviolet rays. The use of such materials can help the latecomers in theaters and auditoriums to locate the unoccupied seats with little or no disturbance to those who are already seated.

Beautiful stage costumes and startling scenic effects can be obtained by the use of fluorescent fabrics. Fluorescent prints in bathing suit designs have been used for many years. The recent introduction of a completely fluorescent bathing suit may well start a trend toward greater brilliance in beach apparel.

Yarns for sweaters have been enriched in shade by the addition of fluorescent dyes. By the incorporation of such dyes in the formula, certain shades of silver, buff, and taupe have been made to appear bright and exhibit a peculiar luminescent tone. Changeable or iridescent shades on wool, silk, acetate, and nylon can be produced by a careful blending of fluorescent and other dyes. Such shades have the fascinating property of appearing different with each movement of the fabric depending upon the angle of view.

The appearance of dull, cream, or other off-tone whites can be greatly improved by an aftertreatment with dyes such as Calco Acetate Fluorescent Blue I or Calcomine Fluorescent Violet 2G.* A colorless but blue fluorescing dye may be incorporated in soap to improve the brightness of laundered clothes. Toilet articles are often tinted with such dyes to increase their eye appeal.

Reviewing the various uses of fluorescent dyes it is found that they fall in four general classifications as follows: (1) ultraviolet light effects, (2) daylight

* Colour Index Numbers, where known, are given in the text or in Table IV.

brightness of shade, (3) optical bleaching, and (4) changeable or iridescent shades. Specific questions dealing with each class of use are discussed later under these subheadings.

Application Problems

If the dyer, designer, and color blender are to produce materials which exhibit a maximum of fluorescence, they must understand some of the factors which influence the brilliance of tone obtained. The brilliance of fluorescence produced by a single dye or by a combination of them is often reduced at high concentrations; therefore, highly fluorescent blacks, navy blues, browns, and other deep shades cannot be produced.

Concentration also controls the color of the emitted light. For example, a light percentage dyeing (1/16 percent of the weight of wool) of Calcomine Brilliant Flavine S produces a blue whereas a heavy percentage dyeing (2%) produces a golden yellow. The location of the dye, whether on the outer parts of the fiber or uniformly distributed within the fiber, also influences the fluorescence. Dye deposited on the outer parts of the fiber only will crock off and the material will appear dull. The same amount of dye molecularly dispersed throughout the fibers will increase the brilliance of fluorescence.

With a few exceptions, the powders of dyes do not show any fluorescence. However, the fluorescent characteristics are developed when the same dye is dissolved and distributed in a suitable medium, such as a solvent or textile fiber. The brightness of emission is governed to some extent by the kind of textile material to which the dye is applied.

A study of the quenching of fluorescence by the use of non-fluorescent and fluorescent dyes in combination, indicates that certain combinations produce greater brilliance than do others and that the brightness of a shade can be enhanced, subdued, or quenched by the addition of different dyes. A further discussion of the above factors which affect fluorescence, namely, concentration effects, substrate effects, and toning dye effects is given under the sub-headings "Factors Affecting Fluorescence", and "Explanation of Some Fluorescent Phenomena."

Theory of Fluorescence

When radiant energy attempts to pass through matter, it may be absorbed. The absorbed energy cannot disappear but must reappear in some manner. Most frequently this absorbed energy reappears as heat, that is, the material which absorbs light becomes warmer. A second way in which this energy can be dissipated is by inducing photochemical action. This happens when cloth is faded by the action of light. A third disposition of absorbed energy is to have it reemitted as visible light. This is the phenomenon known as fluorescence and is of interest the the present study.

A complete study of fluorescence must include an investigation of the radiant energy which is used for excitation. It must include the characteristics of the dye by which it is able to absorb this radiant energy. The physical state of the dye molecule which enables it to emit fluorescence light rather than to dissipate the energy in one of the more usual methods is important. Finally it must note the characteristics of the emitted light.

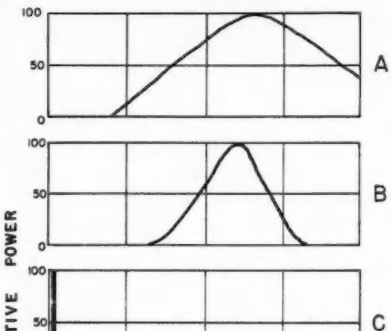

Figure 1. Energy Distribution of Various Ultraviolet Sources

A—Argon Lamp
B—Purple X Bulb
C—Cold Quartz Lamp (low-pressure mercury)
D—Hot Mercury Arc (high-pressure mercury)

Sources of Excitation

There are two classes of excitation energy, that is, sources of radiant energy which are of interest in exciting fluorescence. One class is the so-called "black light" or ultraviolet light, which is of interest when the fluorescent sample is the only material which should be visible. The other type of excitation energy is "white light", which is of interest when the reason for using the fluorescent dye is to attain daylight brilliance of color. Four sources of "black light" and three sources of "white light" which are widely used and commercially available are discussed in detail below.

The Argon bulb produces ultraviolet rays by an electrical discharge through rarefied argon. The spectral distribution of the energy from an Argon light is shown by Curve A of Figure 1. It is evident from this curve that the energy given off is predominantly ultraviolet but that it also contains a considerable percentage of visible blue light. These lamps have the advantage of being able to run for as long as 5,000 hours in a standard electrical outlet. However, they have the disadvantage of being of very low power, about 2½ watts; therefore, the total amount of ultraviolet light given off is small in magnitude.

The Purple "X" bulb is a second type of lamp used to produce ultraviolet light. This lamp has a tungsten filament which is run at an electrical over-voltage so that its behavior is similar to the filament in a Photoflood lamp. The glass surrounding the filament is colored a deep reddish violet, it transmits ultraviolet radiation, and absorbs a considerable portion of the visual light. The spectral distribution of the energy from this lamp is shown by Curve B of Figure I. It is quite similar to the curve of the argon lamp in that its ultraviolet output is located at wavelengths just shorter than 400 millimicrons, but it differs from the argon distribution in having relatively less visible light. These bulbs have the advantage of giving off a large amount of energy and of operating from a standard electrical socket. However, they have a disadvantage in that if they are run more than five minutes at one time, they may fail or burst. Even before failure, they are likely to overheat, and this results in a softening and a distortion of the glass envelope.

The "cold quartz light" is a third kind of ultraviolet lamp in which an electrical discharge is carried by mercury vapor at a low pressure (10 microns) inside a quartz tube. With these lamps and a conventional nickel oxide glass filter, i.e. Corning No. 986, 95% of the energy given out is contained in the single mercury line at 253.7 millimicrons. Thus, this distribution is represented by a single vertical line shown in Curve C in Figure I. The cold quartz lamp is very efficient in converting electrical energy into ultraviolet energy but it does require an auxiliary transformer in the electrical circuit and it also has the disadvantage in that most of its energy is given off at a short wavelength which is not very efficient for exciting fluorescene in textile fabrics because of the absorption of radiation by the textiles themselves.

The "hot" mercury arc, a fourth source of ultraviolet energy, is produced by passing an electrical discharge through mercury vapor at a high pressure (8 atmospheres). Since this discharge gives off

considerable visible light, it is usually used in conjunction with a filter which absorbs the visible light and transmits the ultraviolet. The spectral distribution of the energy from this lamp after it is suitably filtered is shown by the five vertical lines of Curve D in Figure 1. Approximately 85% of the energy transmitted by the filter consists of the mercury lines closely grouped at 366 millimicrons. It does have the disadvantages of requiring a transformer in the electrical circuit and of requiring an optical filter so as to cut out the portion of the light which otherwise would be visible. Further, it requires approximately 5 minutes to reach full intensity, and also approximately 5 minutes to cool before it will relight. However, because this lamp is able to run continuously for long periods of time and emits ultraviolet of a wavelength which is quite efficient in exciting fluorescence in many textile samples it is probably the most widely used.

The first of the "white lights" which is of interest is sunlight. Although sunlight varies widely in its spectral distribution, one distribution which has been used as a standard *(2)*, is shown by Curve A of Figure 2. This curve indicates that sunlight has about fifteen times as much energy in the visual range from 400 to 700 millimicrons as it has in the ultraviolet range at wavelengths shorter than 400 millimicrons.

The tungsten light or ordinary incandescent lamp is a second common source of white light. The color of these lamps differs, depending upon the wattage and age of the lamp, but a typical curve (representing a color temperature of 2848° K.) is shown by Curve B of Figure 2. It is evident from this curve that the incandescent lamp gives off about thirty times as much energy in the visible range from 400 to 700 millimicrons as it gives off in the ultraviolet range at wavelengths less than 400 millimicrons.

An increasingly important "white light" is the fluorescent lamp. In the fluorescent lamp, a mercury arc is created electrically by discharge inside a tube, the walls of which are coated with a phosphor. This phosphor absorbs the ultraviolet light nd converts it into visible light. Some of the visible mercury lines are transmitted by the phosphor and glass envelope. There are several kinds of fluorescent lamps made, varying mainly in the phosphor, and Curve C of Figure 2 represents one of these that is known as a "daylight" fluorescent lamp. Curve C shows not only the continuous spectral distribution resulting from the phosphor light but also four vertical lines representing the direct emission of mercury line spectra.

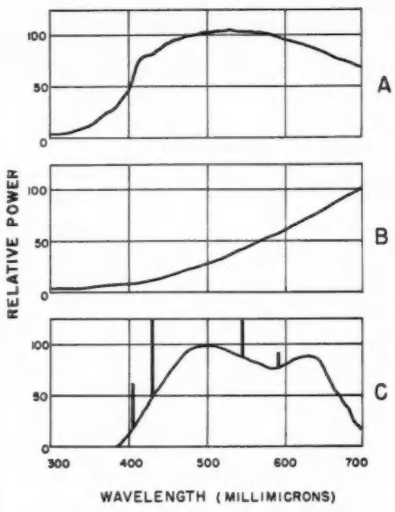

Figure 2. Energy Distribution of Various Light Sources
A—Sunlight
B—Incandescent Light
C—Daylight Fluorescent Light

Absorption of Dyes

In the process of fluorescence, the radiant energy is first absorbed by the dye. The absorption of a dyed textile is indicated by its spectrophotometric curve in which reflectance is plotted as a function of wavelength. A more complete knowledge of the fluorescent phenomenon in any particular case, necessitates having such a spectrophotometric curve. There are, however, certain difficulties in obtaining such a curve. It is very difficult to measure reflectances in the ultraviolet. The Beckman spectrophotometer, which is satisfactory for measuring ultraviolet transmittance of solutions, lacks sufficient sensitivity to measure reflectance samples in this range. In the visual range, although there is enough sensitivity with either the Beckman or the General Electric spectrophotometer, the difficulty is that the absorbed light may be re-emitted in a form to which the photocell is responsive and thereby result in erroneous readings.

On the other hand, there is no problem in measuring the absorption curve of a solution. In a solution, the dye molecules are randomly oriented and the fluorescence light which they produce is emitted equally in all directions, regardless of the direction of the incident light. The light, which is transmitted without absorption, passes through in a straight line and may be allowed to strike a photocell which is shielded from the emitted light. It is thus possible to differentiate between these two kinds of light and to obtain a true measure of transmittance not influenced by the fluorescent light. In spectrophotometers it is possible to accomplish this by a suitable positioning of the solution cell with reference to the photocell.

The question arises: Is the absorption curve in solution, which may be measured easily, indicative of the absorption curve on the fiber, which may not be measured? In order to answer this, it is necessary to compare the absorption curve of the solution with the absorption curve of the fiber. Figure 3 shows a comparison of Calcocid Rhodamine B Conc. measured in water at a pH of 5 and also measured on wool. Instead of plotting reflectance for the wool dyeing and transmittance for the water solution which would give two curves not readily comparable, the data in both cases have been reduced to logarithm of absorbancy. Curve A is obtained from a water solution and represents the true absorption curve of the dye. Curve B represents the instrument plotted curve of the dyed fiber. It deviates from the true absorption curve, as indicated by solution, primarily in the regions where fluorescence is known to have a large effect. In studying the curve and compensating qualitatively for erroneous high reflectance in the fluorescent region, it is evident that the curves are quite similar. A comparable study was made of the five other dyes listed in Tables 1 and 2, nd in every case it was found that the absorption curve in solution was very closely related to the absorption curve by reflectance, when allowance was made for

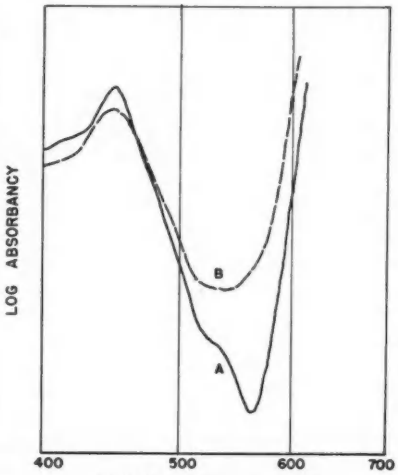

Figure 3. Comparison of Solution Curve and Wool Curve of Calcocid Rhodamine B Conc.; Smaller Log Absorbancy at the Top of the Plot.
A—Water solution at pH 5, log absorbancy = log log (1/T) where T = Transmittancy, vertical position arbitrary
B—Wool dyeing, log absorbancy = log [(1—R)²/2R] where R = Reflectance, vertical position arbitrary

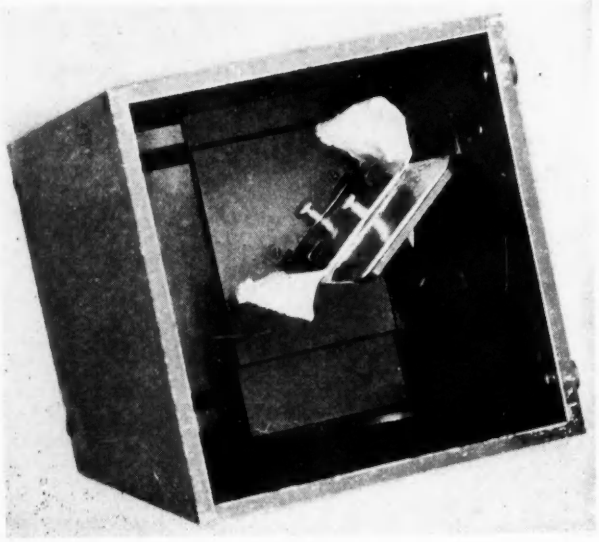

Figure 4. Photograph of Attachment for Cary Spectrophotometer for Measurement of Fluorescence Energy Distribution.

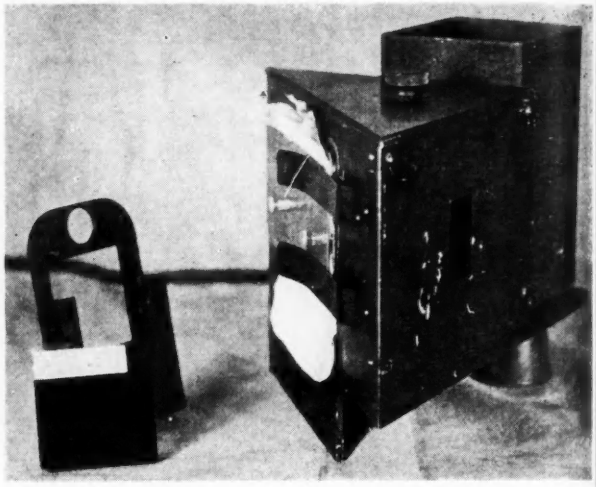

Figure 5. Photograph of Attachment for Beckman Spectrophotometer for Measurement of Fluorescence Intensity.

the error introduced by the fluorescent light. For this comparison, these dyes were measured only in the visual range.

Figures 10 to 25 represent the solution absorption curves of sixteen dyes listed in Table IV. It should be remembered not only that these are not exactly the same as the absorption curves by reflectance, but also that their absorption of ultraviolet is probably interfered with in part by the ultraviolet absorption of the various textile fibers. However, in view of the data in Figure 3, it is believed that these solution curves give a good qualitative indication of the absorption on the fiber and may be used to predict fluorescent phenomena.

Emission of Dyes

According to Stokes' law, the emitted light is either of equal or longer wavelength than the absorbed radiant energy. The efficiency with which the absorbed light is transformed into fluorescent light varies greatly among dyes, those dyes of commercial interest being of highest efficiency. According to Fonda *(3)*, such commercial dyes approach an efficiency of 50%.

Dyeings of the sixteen dyes listed in Table IV were examined under the light of a mercury arc after it had passed through a quartz spectroscope and two observations which applied to all sixteen were made. In the first place, fluorescence was excited by any wavelength of light equal to or shorter than the main absorption band of the dye in the visual range. In the second place, it was observed that the color of the fluorescence for each dye was independent of the wavelength of excitation.

The fluorescence light which is emitted by the dye is the light which strikes the eye and is the useful end result. There are two characteristics of this light which are important: one is the intensity; the other is the color. The intensity of the light can be measured with a fluorophotometer. Figure 5 shows an attachment for the Beckman Spectrophotometer which may be used for this purpose. This instrument is equipped with a hot mercury vapor source and a photocell filter combination which has a sensitivity response somewhat similar to that of the human eye and is used to measure the amount of visual light.

In order to study the distribution of the intensity of the fluorescent light, the source of the exciting light was unimportant because the observations with the quartz spectograph described above showed that this is not a factor in determining the color of the fluorescence. A high-pressure mercury arc with an ultraviolet transmitting filter was used to excite the samples for measurements of quality of fluorescence light. A Cary spectrophotometer was used to measure the distribution of the emitted light which is presented in Figures 10 to 25. Figure 4 shows the attachment for the Cary in-

TABLE I

Comparison of Light Absorption of Dyes

Figure #	*Dye*	*Absorption Maximum Wavelength*	*Absorbancy Index**	*Solvent*
10	Calcocid Brilliant Flavine FS.....	416	24	Water, pH 7
11	Calco Acetate Fluorescent Yellow HEB	438	8.5	Ethanol
13	Calcomine Brilliant Flavine S.....	375	30	Water, pH 7
19	Calcozine Red BX Conc.....	560	235	Water, pH 3
20	Calcocid Rhodamine B Conc.....	563	153	Water, pH 5
21	Calcomine Fluorescent Violet 2G....	350	17	Water, pH 7

* Absorbancy Index = as in the equation $-\log_{10} T_s = a_s lc$

where

T_s = Transmittancy

a_s = Absorbancy index (1000 cm.^{2}/gm.)

l = length of the absorption path (cm.)

c = concentration (gm./1000 cm.^{3})

TABLE II

Comparison of Light Emission of Dyes

Figure	*Dye*	*Dominant Wavelength*	*Relative Energy*	*Fiber and Concentration*
10	Calcocid Brilliant Flavine FS.....	544	46	2% on wool flannel
11	Calco Acetate Fluorescent Yellow HEB	551	41	2% on bright acetate
13	Calcomine Brilliant Flavine S.....	467	27	2% on bright viscose
19	Calcozine Red BX Conc.....	609	20	½% on wool flannel
20	Calcocid Rhodamine B Conc.....	622	12.5	2% on wool flannel
21	Calcomine Fluorescent Violet 2G....	473	100	2% on bright viscose

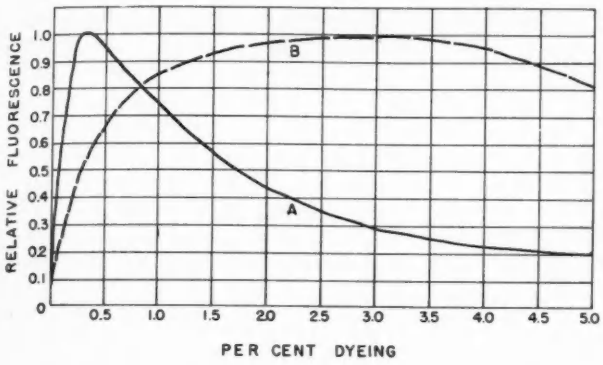

Figure 6. Effect of Concentration on Fluorescence Intensity.
A—Calcocid Rhodamine B Conc. on Wool
B—Calcocid Brilliant Flavine FS on Wool

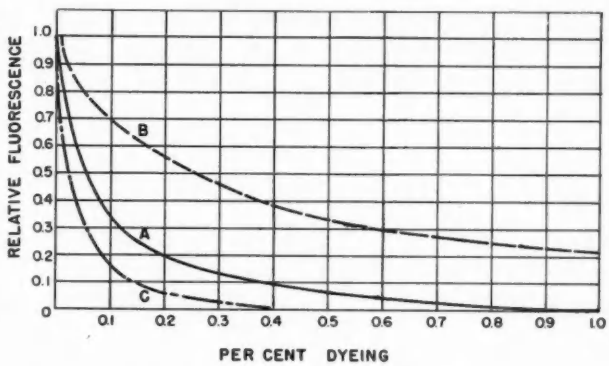

Figure 7. Effect of Concentration of Toning Dyes on Fluorescence Intensity.
A—Calcocid Blue ALB
B—Calcocid Blue CFF
C—Calcocid Blue SAPG
% dyeing indicates the amount of A, B or C added to a 1% dyeing of Calcocid Rhodamine B Conc. on wool.

strument which was used in these measurements.

Quantitative data on the absorption and emission of six of the dyes of greatest importance for textiles applications are given in Tables I and II.

It is interesting to note from the data on the sixteen dyes measured, that in all cases the emission curve of the fluorescent light is immediately adjacent to the absorption curve. This seems so widespread among dyes that it is highly improbable that a colorless organic material, hence having no absorption in the visual range can be found which will fluoresce red, when dyed on textiles. Figure 22 shows that Calcocid Fluorescent Blue G has a fluorescent emission at a shorter wave length than its absorption maximum. This apparent variation from the general rule would lead one to the correct conclusion regarding its nature, namely, that it is a mixture of a non-fluorescent blue dye and a fluorescent colorless dye.

Factors Affecting Fluorescence

The dye must be in a satisfactory physical and chemical condition to fluoresce. There are several factors which can influence the fluorescence of a dye. *Fonda (3)* has shown that the fluorescence of Rhodamine B decreases with concentration. As the concentration increases, the probability of collision between dye molecules also increases and with it the opportunity for the energy of an activated molecule to be dissipated into other forms rather than to be converted into light.

Figure 6 shows how the relative intensity of the fluorescence varies as a function of the concentration expressed in terms of percent dyeing. Two types of behavior are shown. In one of these, the Calcoid Rhodamine B Conc., C.I. 748, the fluorescence reaches a maximum at a very low concentration and then drops off quite rapidly. In the other, the Calcocid Brilliant Flavine FS, the fluorescence builds up slowly with concentration, reaches a maximum, and then drops very slowly. These data show that an optimum concentration can be chosen to produce a maximum degree of fluorescence. Another factor which is important in determining the amount of fluorescence is the substrate, that is, the material which contains the dye. Table III shows how the intensity of fluorescence varies for Calcomine Brilliant Flavine S with different kinds of material.

A third factor is the presence of other coloring materials. The fluorescence of Calcocid Rhodamine B Conc. is reduced if blue dyes are present. However, the presence of other dyes do not have identical effects as is shown by the data of Figure 7. For instance, if Calcocid Blue CFF, C.I. 715, is added it has an effect of making the wool appear blue but does not rapidly reduce the fluorescence. On the other hand, if Calcocid Alizarine Blue SAPG, C.I. 1054, is added, it reduces the fluorescence very rapidly. Calcocid Alizarine Blue AlB, C.I. 1075, has an intermediate effect. Thus, suitable dyeing combinations should be chosen to give the desired daylight color by reflectance and to give the desired fluorescence with ultraviolet radiation.

Other coloring materials may be incorporated to produce the daylight color and fluorescence either by adding the toning dye in the dyeing formulation, or by blending separately dyed fabrics. The addition of a non-fluorescent dye to a fluorescent dye by both of these methods showed they are equally effective.

TABLE III

2% Calcomine Brilliant Flavine S on Different Fibers

Material	Fluorescence Intensity
Bright Acetate	100
Nylon	96
Bright Viscose	40
Linen	34
Aralac	34
Bright Bemberg	33
Pure silk	32
Cotton	28
Wool	26

Explanation of Some Fluorescent Phenomena

When fundamental data are available for the dyes of interest, it is possible to explain and understand some of the phenomena of fluorescence. For instance, in the simple case of straight fluorescence, Calcocid Brilliant Flavine FS has strong absorption at 365 millimicrons (Figure 10 solid line); therefore, when it is subjected to irradiation from a high-pressure mercury arc which gives off 365 millimicrons radiation, (Figure 1D), it absorbs large amounts of this light. The emitted light is in the green (Figure 10 dotted line), which corresponds to a high part of the sensitivity curve of the eye so that it is easily visible. Good fluorescence results when nothing interferes with this process.

It is characteristic of Calcocid Brilliant Flavine FS when dyed on wool that the color of the fluorescent light does not change greatly as the concentration is increased. On the other hand, as the concentration of Calcomine Brilliant Flavine S increases the color of the fluorescence light changes from a blue-white at 1/16% to a golden yellow at 2%. This behavior is partly predictable from the data of Figure 10 and 13. (Another factor is a colorless, blue fluorescing impurity in the commercial product.) The absorption

curve of Calcocid Brilliant Flavine FS (Figure 10) has a very steep cut-off. In the region from 450 to 500 mμ the curve is very steep. Thus at no concentration is the absorption at 500 mμ appreciable and the emitted fluorescence light is not subject to attenuation at this wavelength. On the other hand, the absorption curve of Calcomine Brilliant Flavine S shows a gradual slope over the range 400 to 500 mμ. This curve is said to have a sloping or poor cut-off. There is a moderate absorption at 500 mμ. Since at low dye concentration this is not sufficient to attenuate the fluorescence light, this then has a blue component. At higher dye concentration, this absorption becomes appreciable, the 500 mμ light is attenuated, and the color of the fluorescence light changes with increasing concentration toward a golden yellow shade. In this manner, these data can be used to predict changes in shade of fluorescence light with changes in dye concentration, the change in shade being proportional to the slope of the cut-off, with steep cut-off dyes being relatively unchanged.

The behavior of the three blues in combination dyeings with Calcocid Rhodamine B Conc. is explained by the absorption curves of Figure 8, which show the overlapping of the curves of two blues and the lack of contact by the other. It is apparent from the figure that the Calcocid Blue CFF has the least absorption over the wavelength range of the fluorescence emission of the Calcocid Rhodamine B Conc., hence, its presence has the least effect on the emission.

Ultraviolet Light Effects

One problem in "black light" effects is to produce maximum brilliance in all possible shades without regard for daylight appearance. The first approach to such a gamut of colors is the use of individual fluorescent dyes, and their concentrations should be adjusted to give maximum intensity in accordance with the behavior illustrated by Figure 6. Some of these fluorescent dyes can be improved by the addition of toning dyes. For instance, in light shades, the fluorescence of the Calcozine Brilliant Flavine S closely approaches white, because the band of light emitted is so broad. In order to improve the purity of shade, it is necessary to narrow the wavelength band of emitted light. This is done by adding a non-fluorescent dye which absorbs some of the emitted light. For example, the emission curve of Calco Fluorescent Blue I is somewhat broad and the addition of Calco Acetate Sapphire Blue 2 GS absorbs the longer wavelengths of the emitted light, thereby reducing the width of the band and thus improving the purity of the blue color under ultraviolet light.

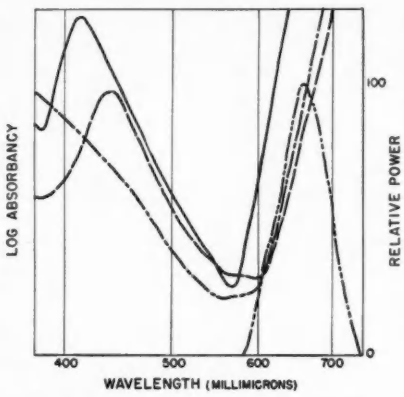

Figure 8. Overlapping of Absorption Curves of Three Toning Dyes with Emission Curves of Calcocid Rhodamine B Conc.
A—Absorption of Calcocid Blue CFF on Wool
B—Absorption of Calcocid Blue SAPG on Wool
C—Absorption of Calcocid Blue ALB on Wool
D—Emission of Calcocid Rhodamine B Conc. on Wool

As an example of the use of these data let us suppose that it is desired to produce a fluorescent green. Since green light has a dominant wavelength of 550 millimicrons, it is necessary to have an emission curve which is high at 550 millimicrons. In order to obtain a rich green, it is also necessary to have a narrow emission band. Consider the emission curve for Calcocid Rhodamine B Conc., shown in Figure 20. This has no emission at 550 millimicrons and therefore it is impossible to make this dye fluoresce green by the addition of any combination of dyes. Consider the curves of Figure 13, Calcomine Brilliant Flavine S, and Figure 10, Calcocid Brilliant Flavine FS. Both of these have considerable light emitted at 550 millimicrons and therefore both of them can be used to produce green fluorescence by the addition of non-fluorescent dyes. Since the emission at 600 millimicrons is less for the Calcocid Brilliant Flavine FS, the inherent color of the fluorescence is greener, but both dyes would require the addition of a blue or green dye to produce a true green fluorescence.

At times it is desirable to broaden the band of emission. For instance, to produce an orange with the dyes listed in Table IV, it is necessary to combine fluorescent reds and yellows. A brilliant fluorescent orange can be produced on wool by blending the correct proportions of Calcocid Rhodamine B Conc., and Calcocid Brilliant Flavine FS.

Another problem in ultraviolet light effects is to produce fluorescent shades which are an approximate match, in daylight, to a non-fluorescent shade. Manufacturers of fluorescent carpets for theatres, night clubs, etc., are confronted with this problem because, in these installations, it is desirable to have all the carpet appear alike when the white lights are on, but to have only the aisle carpet fluoresce in ultraviolet light. In this type of problem, it is generally easier to establish first the fluorescent shades which have the required degree of fluorescence, and then to match these by daylight as closely as possible with non-fluorescent dyes.

Sometimes, in an effort to improve the fastness to light of fluorescent shades dyed with Calcocid Brilliant Flavine FS, additions of a relatively light-fast non-fluorescent yellow such as Calcocid Yellow MCG, C.I. 640, or Calcocid Fast Yellow 3G, C.I. 636, are made. Such additions may also be used in certain cases where it is necessary to increase the body of the daylight shade without increasing the intensity of fluorescence under ultraviolet light. While such additions have very little effect on the daylight appearance, Figure 9 shows that the intensity of fluorescence may be reduced to zero if sufficient non-fluorescent dye is added.

Daylight Brightness

In order to have a bright shade, it is necessary to absorb strongly some parts of the spectrum and to reflect strongly other parts. For example, a blue dye absorbs the red part of the spectrum and reflects the blue part. A blue will appear brighter if it is possible to increase the reflectance of the blue light without sacrificing absorption of the red light. This can be accomplished by the addition to the formulation of a fluorescent dye which fluoresces strongly in the blue part of the spectrum, and does not absorb in this region. A review of the figures shows that Calco Acetate Fluorescent Sea Green, Calco Acetate Fluorescent Blue I, and Calcomine Fluorescent Violet 2G meet this requirement. A practical dyeing of 0.6% Calcosol Blue 3G Paste, C.I. 1109, on wool slubbing was greatly improved in brightness by the addition of 0.10% Calco Fluorescent Blue I.

In the case of a red, the blue-green parts of the spectrum are absorbed, and the red part is reflected. In order to increase the brightness, it is necessary to add a fluorescent dye, the emission curve of which is in the red and which does not absorb in that region. Examination of the figures shows that suitable dyes for this purpose are Calcocid Rhodamine B Conc., Calcozine Red BX Ex., and Calcozine Red 6G Ex. For application on wool, Calcocid Rhodamine B Conc. is recommended be-

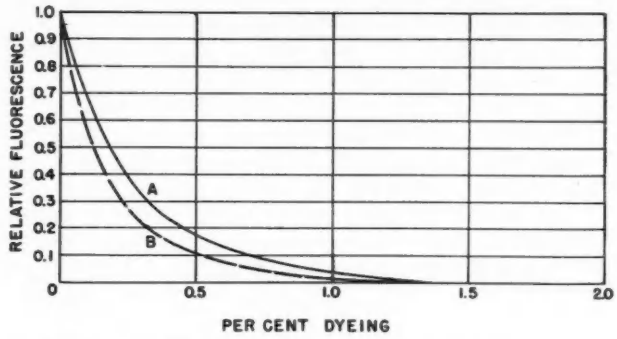

Figure 9. Effect of Concentration of Dyes Used to Increase the Body of the Color.

A—Calcocid Fast Light Yellow 3G
B—Calcocid Yellow MCG

% dyeing indicates the amount of dye A or B added to a 1% dyeing of Calcocid Brilliant Flavine FS on wool.

cause of its superior leveling properties in a strongly acid dye bath. In addition to improving the brightness, it is also possible to alter the shade by the addition of a colorless blue fluorescing dye. For example, it was found that a 0.1% dyeing on wool of Calcoloid Pink FFD was changed to a very desirable bluish pink by the addition of 0.3% Calco Acetate Fluorescent Blue I.

It may be of interest to note that dyes such as Calco Acetate Fluorescent Blue I absorb the invisible near ultraviolet part of the spectrum and re-emit this as useful visible light. Dyes such as Calcocid Brilliant Flavine FS absorb not only the invisible near-ultraviolet rays, but also the visible violet and blue rays and convert these to the more easily seen greenish-yellow rays. Dyes such as Calcocid Rhodamine B Conc. convert the green light of the visible spectrum into orange-red rays which brighten the shade. Experiments have shown that Calcocid Rhodamine B Conc. dyed on wool will fluoresce when excited with the visible yellow rays emitted by sodium lamps.

Optical Bleaching

Until recently it has been customary to improve the whiteness of processed materials either by adding a blue or violet colorant or by destroying or decolorizing the yellow components with chemical bleaches. Both of these methods tend to give the cloth a uniform reflectance at all wavelengths. This same result can also be obtained by a treatment which has been called optical bleaching. This consists of adding a colorless material which fluoresces blue.*

One consideration is the color of the fluorescent light. The characteristics of the emitted light are shown in the emission curves, Figures 10 to 25. The four dyed in this group which might be used for this application are the Calco Acetate Fluorescent Sea Green, Calco Acetate Fluorescent Blue I, Calcomine Fluorescent Violet 2G, and a fluorescent aminostilbene compound. Examination of the emission curves of these four compounds shows that the maximum for the Sea Green falls at 520 mμ while the maximums for the other three fall at 430-450 mμ. From this it can be concluded that the Sea Green is not satisfactory because it will result in too green a shade of white. Insofar as the emission curves of the other three are concerned, any could be used, but in the specific case of wool, the Calco Acetate Fluorescent Blue I is recommended. However, in the case of cotton or rayon, Calcomine Fluorescent Violet 2G or other colorless fluorescent dyes are recommended.

The intensity of the visual fluorescence varies widely from tungsten light to daylight. From Figure 23 it is evident that Calco Acetate Fluorescent Blue I absorbs energy in the neighborhood of 350 mμ and re-emits this in the neighborhood of 450 mμ. It is also evident from the data shown in Figure 2A and 2B that daylight has relatively more energy in the neighborhood of 350 mμ than has tungsten light. It is, therefore, to be expected that the optical bleaching will be more efficient in daylight. To the textile man concerned with quality control, this means that a standard light source should be adopted for evaluating mill runs. Some of the specific applications of optical bleaching are the use of these products in the scouring of wool, bleaching of cotton, discharge printing of wool and cotton, and laundering of cotton. There are also applications for paper, leather, and other white materials.

* To evaluate this type of sample with a spectrophotometer it is necessary to have a type of instrument which irradiates before it monochromates.

Changeable or Iridescent Shades

A characteristic behavior of cloth dyed with fluorescent dyes is that the apparent hue or color will vary, depending upon the angle of illumination and of viewing. When a piece of satin cloth is dyed with Calcocid Rhodamine B Conc. and is crumpled, it will have areas of highlights and shadows. The shadows will appear yellowish because the fluorescence light predominates, whereas the highlights will appear bluish because the directly reflected light predominates. This changeableness or iridescence is a very desirable effect in some end uses such as stockings, dresses, or lustrous fabrics.

Another characteristic of shades which contain fluorescent dyes is that they are very difficult, if not impossible, to match unless the identical dyes are used. A good color match is one which will be a match under all types of illumination and under all angular conditions of view. Daylight contains a higher proportion of ultraviolet than does tungsten light, as is evident by curves A and B of Figure 2. Therefore, when a fluorescent sample is viewed in daylight, a greater amount of fluorescence is excited and this, combined with the normally reflected light, gives the fluorescent dyed sample a greater over-all brilliance. This over-all appearance might be matched by a combination of non-fluorescent dyes, provided one angular condition was carefully specified and the illumination was not changed. However, when the illumination is changed from daylight to incandescent light, which has lower proportion of ultraviolet, less fluorescence light is produced and the over-all appearance of the sample will change to be predominantly the color of the normally reflected light. For this reason, shades containing fluorescent dyes are difficult to match.

Summary

Spectral distribution data of sixteen fluorescent dyes have been obtained for absorption in solution and for emission when dyed on textile fibers. It has been shown that the absorption in solution is somewhat similar to absorption on the textile material so that the data are qualitatively useful in the prediction of fluorescence phenomena. Spectral distribution data are given for four common sources of ultraviolet radiation, namely, the Argon lamp, the Purple-X bulb, the high-pressure mercury arc, and the low-pressure mercury arc. Distribution data are also given for three white lights, namely, daylight, incandescent light and fluorescent lamp.

The effect of various factors on fluorescence has been studied. As the concentra-

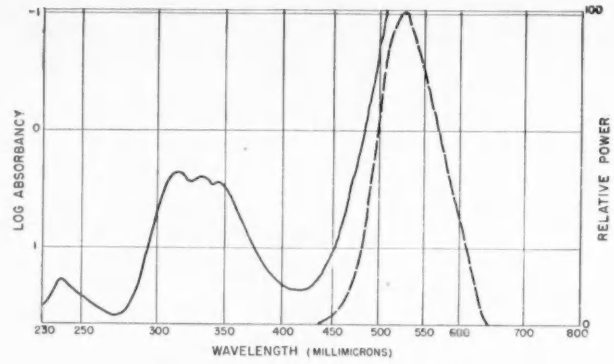

Figure 10. Calcocid Brilliant Flavine FS
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Wool at 2%

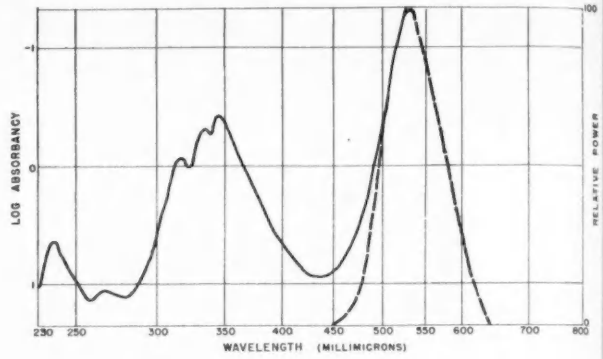

Figure 11. Calco Acetate Fluorescent Yellow HEB
Solid Line—Absorption Curve in Ethanol
Dotted Line—Emission Curve on Bright Acetate at 2%

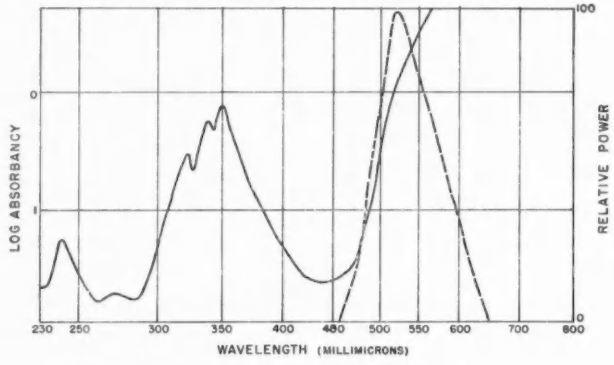

Figure 12. Calco Fluorescent Yellow AB
Solid Line—Absorption Curve in Ethanol
Dotted Line—Emission Curve on Bright Acetate at 1%

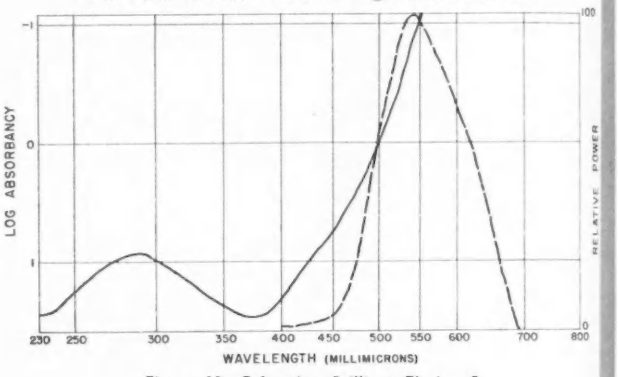

Figure 13. Calcomine Brilliant Flavine S
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Bright Viscose at 2%

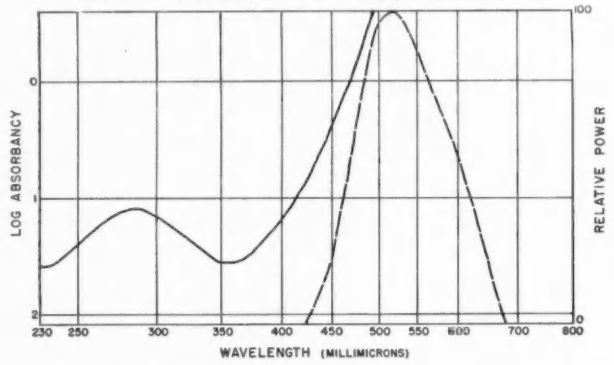

Figure 14. Calcomine Diazo Scarlet PRD (Direct)
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Bright Viscose at 1%

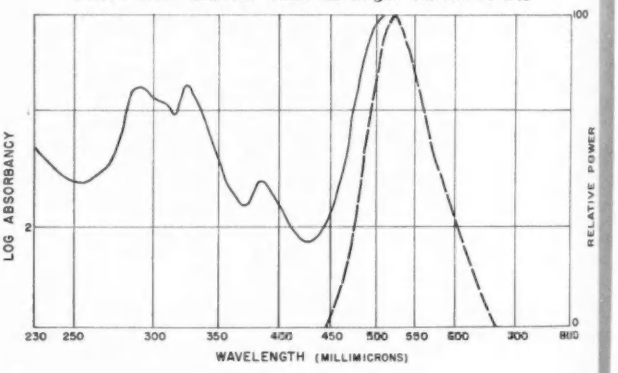

Figure 15. Calcozine Yellow OX
Solid Line—Absorption Curve in Ethanol
Dotted Line—Emission Curve on Wool at 1%

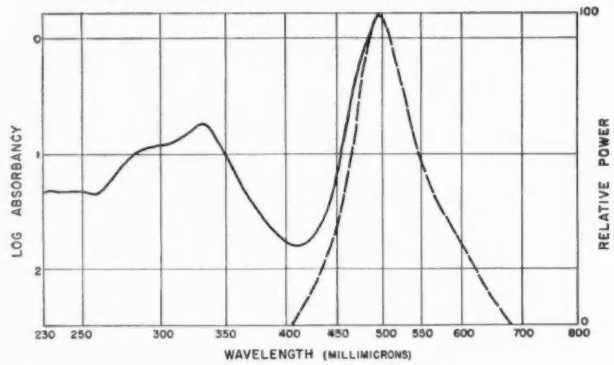

Figure 16. Calcozine Flavine TG
Solid Line—Absorption Curve in Water at pH 3
Dotted Line—Emission Curve on Wool at 1%

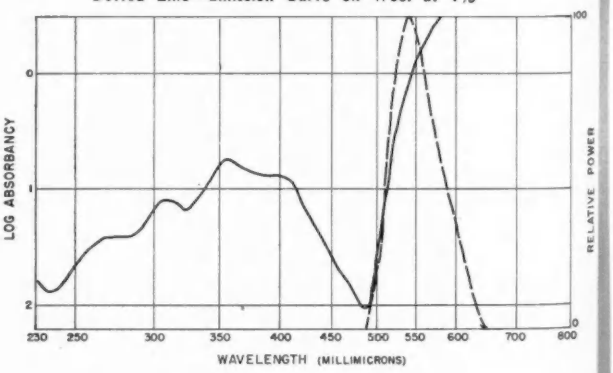

Figure 17. Calcocid Uranine SM
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve in Water at pH 7

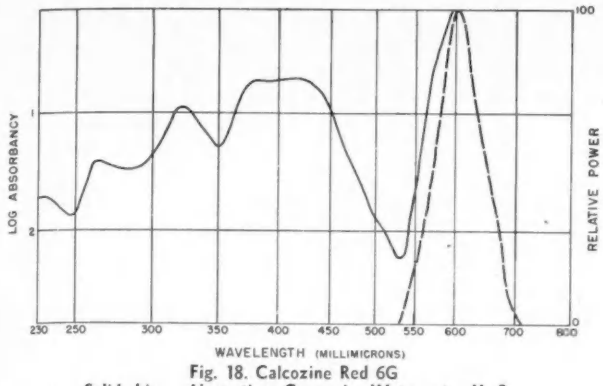

Fig. 18. Calcozine Red 6G
Solid Line—Absorption Curve in Water at pH 3
Dotted Line—Emission Curve on Wool at 1%

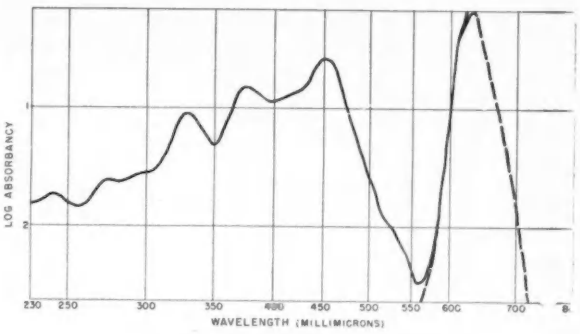

Figure 19. Calcozine Red BX Conc.
Solid Line—Absorption Curve in Water at pH 3
Dotted Line—Emission Curve on Wool at 2%

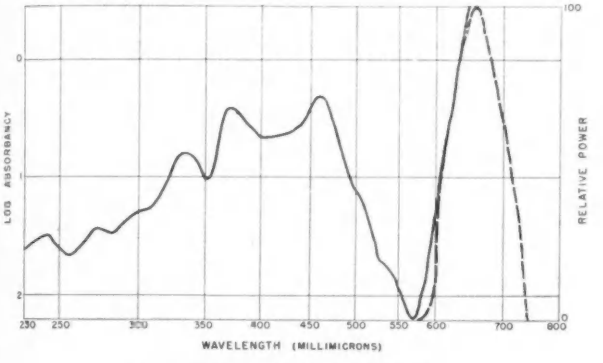

Figure 20. Calcocid Rhodamine B Conc.
Solid Line—Absorption Curve in Water at pH 5
Dotted Line—Emission Curve on Wool at 2%

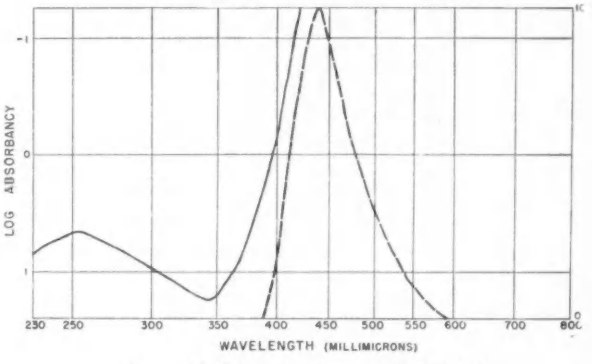

Figure 21. Calcomine Fluorescent Violet 2G
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Bright Viscose at 2%

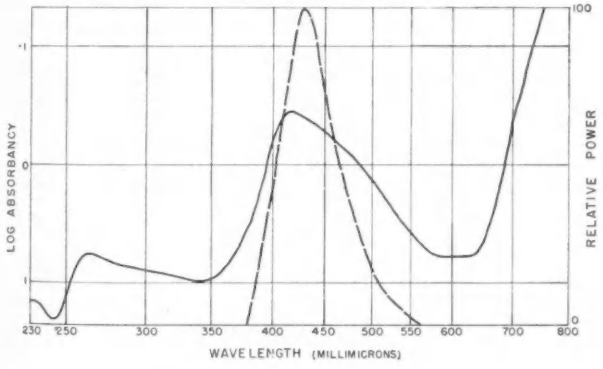

Figure 22. Calcocid Fluorescent Blue G
Solid Line—Absorption Curve in Water at pH 5
Dotted Line—Emission Curve on Wool at 1%

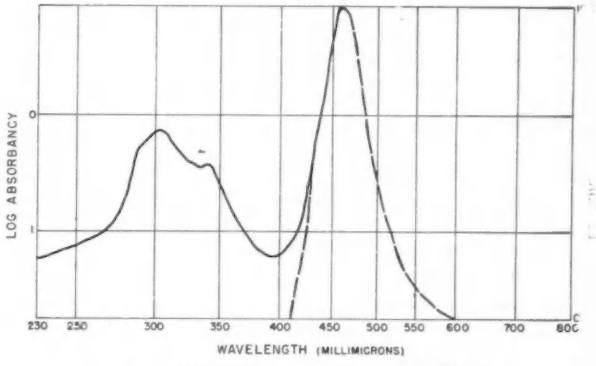

Figure 23. Calco Acetate Fluorescent Blue I
Solid Line—Absorption Curve in Methanol
Dotted Line—Emission Curve on Bright Acetate at 1%

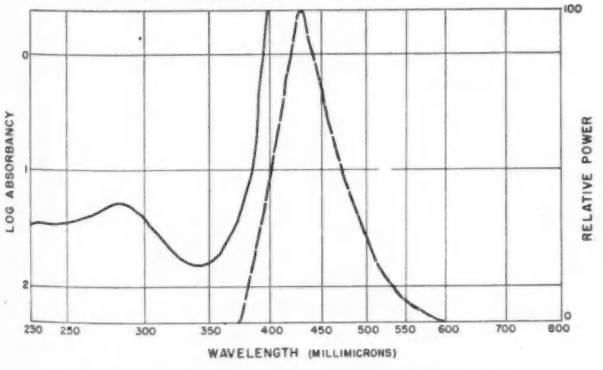

Figure 24. Fluorescent Aminostilbene Compound
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Cotton at ¼%

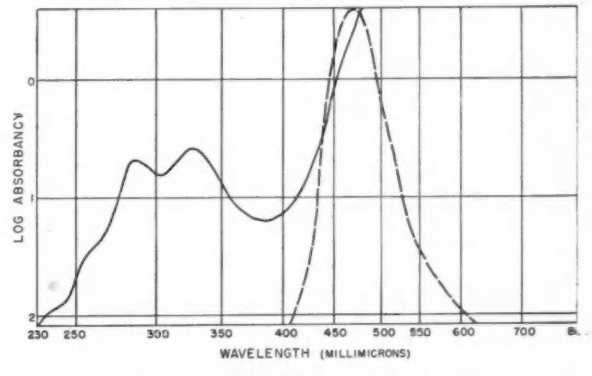

Figure 25. Calco Acetate Fluorescent Sea Green
Solid Line—Absorption Curve in Water at pH 7
Dotted Line—Emission Curve on Bright Acetate at 1%

TABLE IV

Measurement Conditions of Dyes

Figure	Dye	C.I.	Absorption Data	Emission Data
10	Calcocid Brilliant Flavine FS.....	...	pH 7 water	2% on wool
11	Calco Acetate Fluorescent Yellow HEB	...	Ethanol	2½% on bright acetate
12	Calco Fluorescent Yellow AB	...	Ethanol	1% on bright acetate
13	Calcomine Brilliant Flavine S	...	pH 7 water	2% on bright viscose
14	Calcomine Diazo Scarlet PRD (Direct).	812	pH 7 water	1% on bright viscose
15	Calcozine Yellow OX	655	Ethanol	1% on wool
16	Calcozine Flavine TG.....	815	pH 3 water	1% on wool
17	Calcocid Uranine SM	766	pH 7 water	pH 7 water
18	Calcozine Red 6G	752	pH 3 water	1% on wool
19	Calcozine Red BX Conc.	749	pH 3 water	2% on wool
20	Calcocid Rhodamine B Conc.....	748	pH 5 water	2% on wool
21	Calcomine Fluorescent Violet 2G.....	...	pH 7 water	2% on bright viscose
22	Calcocid Fluorescent Blue G.....	...	pH 5 water	1% on wool
23	Calco Acetate Fluorescent Blue I.....	...	Methanol	1% on bright acetate
24	Fluorescent Aminostilbene compound ..	...	pH 7 water	¼% on cotton
25	Calco Acetate Fluorescent Sea Green...	...	pH 7 water	1% on bright acetate

tion of Calcocid Rhodamine B Conc. on wool is increased, the fluorescence increases and decreases very rapidly, having a sharp maximum at 0.3%, whereas the behavior of Calcocid Brilliant Flavine FS on wool is quite different, having a very broad maximum between 1.5 and 4.0%. Concentration also affects the color of the fluorescence. Calcomine Brilliant Flavine S gives a yellow light at a 2% dyeing on wool and a blue light at 0.06%. This is in part explained by the sloping nature of the absorption curve and in part explained by the impurities present in the commercial product. The effect of substrate is illustrated by Calcomine Brilliant Flavine S which shows a wide variation in intensity at 2% concentration, being brighter on unpigmented viscose rayon. The effect of toning colors is illustrated by three blue dyes added to Calcocid Rhodamine B Conc. It was found that Calcocid Blue CFF had the least effect and this was explained by the fact that its absorption band had the least interference with the emission band of the Rhodamine.

One of the main uses of these dyes is in "black light" effects. In this application a material becomes visible by giving off a glow of light when excited by ultraviolet radiation. A problem here is to produce a full range of colors. This may be done by adding ordinary dyes to the formulation, such dyes being chosen so that their absorption bands will narrow the emission bands of the fluorescent dye. Another problem is to produce a shade which is an approximate match in daylight to a non-fluorescent shade. This is best solved by establishing the fluorescent shade first.

A second main use is to produce daylight brightness, that is, to give colored materials an exceptional vividness of tone. For this purpose a fluorescent dye must be chosen which has an emission band in the region where the sample reflects so that the natural reflection of the dyed textile can be augmented by the fluorescence light. The data on the emission characteristics of the sixteen dyes will help in the selection of a suitable fluorescent dye for this purpose.

A third use is in optical bleaching. Whereas "bluings" improve the appearance of white products by absorbing red light, and "bleaches" improve their appearance by destroying the yellow color, "optical bleaches" operate on the entirely different principle of transforming ultraviolet and violet radiation into visible blue light. They have the advantage of giving greater over-all reflectance without tendering the material.

A fourth use is in iridescent effects where the purpose is to give a fabric that will have a different appearance at various angles of illumination and viewing. Almost any fluorescent dye may be used provided its fluorescence is not quenched by the other dyes present. Such shades are very difficult to match unless identical dyes are used.

It is hoped that the fundamental information which has been given for the sixteen dyes investigated, together with the illustrations of the use of these data to predict certain phenomena, will assist the user of fluorescent dyes to derive a maximum utility from them.

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(1) H. E. Millson, Calco Technical Bulletin 571 (1943).

(2) R. Davis and K. S. Gibson, Miscellaneous Publication No. 114 of the National Bureau of Standards (1931).

(3) Fonda, J. Optical Soc. Am. *26* 316-22 (1936).

• PATENT DIGEST •

Correction

In the May 31st issue the patent "Shrinkproofing Wool" etc. on page 383 is incorrectly numbered. The correct number is 2,429,082.

Bleaching—Pretreatment—Padding with Alkalies, Followed by Steaming B, 1

U. S. Pat. 2,433,370
(Buffalo Electro Chemical Comp., Kauffmann et al., Dec. 30, 1947)

The disadvantages of the standard kier boiling operations are summarized as follows: the material is often uneven in absorbency, textile strength and softness; chanelling of the circulating liquor occurs; the impurities, especially the waxy substances, contained in raw cotton goods collect in form of a scum on the surface of the kier and cause spots as also do rust and other dirt particles, loosened from the walls of the boiler. It has been found that the kier boiling procedure can completely be eliminated by an alkali pretreatment of some hours, followed by a short steaming operation. According to an example the goods are impregnated with caustic soda solution. (A concentration of 25-40 gm. per liter has proved to be most efficient). After uniformly wetting the material, excess is removed and the padded goods are laid down in this condition, containing 50-200% liquid (calculated on the weight of the fibrous material) and allowed to steep from 4-20 hours until the waxy substances and the moths are easily detached. After this time the fabrics are steamed for 30 seconds to 30 minutes, according to the coarseness and other conditions of the fiber, and rinsed, either by leading the goods through a steam chamber or in the event of heavy ducks or the like by passing the steam directly through the goods.

PAUL WENGRAF

References cited by the Patent Office are amongst others:

U. S. Pat. 2,267,718 (Du Pont): Textile fabrics are treated in a J-box with an alkaline solution, then with steam and finally subjected to an alkaline treatment at 120-200° F.

(Continued on Page 445)

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American Association of Textile Chemists and Colorists

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JUNE 28, 1948

Twenty-Seventh

Annual Meeting and Convention

Augusta, Georgia, October 21-23, 1948

Photo, Courtesy, Augusta Chamber of Commerce
Julian Smith Park Casino Where Barbecue Will Be Held.

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Future Issues Will Carry Further Information Regarding the Convention

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Photo, Courtesy, Augusta Chamber of Commerce
Sheraton Bon Air Hotel.

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Auspices of Southeastern South Central Piedmont Sections

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Headquarters: Sheraton Bon Air Hotel

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Meeting, WNE Section

THE final technical meeting of the 1947-1948 activities of the Western New England Section was held at the Waverly Inn at Cheshire, Connecticut on Friday, May 21st, 1948. Frederick T. Simon, of Sidney Blumenthal and Company, spoke on "An Application of Spectrophotometry in a Textile Plant". Mr. Simon discussed the use of the spectrophotometer in the standardizing of colors and dye batches and was enthusiastically received by a group of 37 members and guests.

Dr. J. E. Lynn announced plans for the first annual outing for this Section which is to be held on June 18th at the Wallingford Country Club, Wallingford, Connecticut.

Respectfully submitted,
Edward A. Murray, *Secretary.*

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Meeting, Philadelphia Section

A MEETING of the Philadelphia Section was held on May 14th at Kugler's Restaurant in Philadelphia, with James Dixon, Vice-Chairman, presiding. John W. Jordan, described details of the Annual Outing to be held on June 11th at the Atlantic City Country Club, Northfield, N. J. W. O. Neeb, speaking for the membership Committee, reported 771 Senior members as of May 1st, with prospects of many more. Speaking for Chairman, the Secretary announced the Nominating Committee for 1949 Officers as:—Arthur W. Etchells, *Chairman;* William Ebersold, Elmer C. Bertolet, Arthur E. Jones, Harold Dohner.

A report from this group was requested for our next meeting on September 24th.

M. H. Klein introduced the speaker, Harry F. Creegan, Head of Dyeing & Finishing Division, Textile Research Dept., American Viscose Corp., who spoke on "Dyeing and Finishing of Rayon". Mr. Creegan was assisted in the question period by Irving Welsh and L. Leslie Walmsley of the same company. The prize for the question period was won by Joseph L. Wauters of Bailey Dye Wks. 155 were present.

Respectfully submitted,
Thomas H. Hart.

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Meetings of the Bradford Durfee Technical Institute Student Chapter

AT a meeting of the Bradford Durfee Technical Institute Student Chapter on May 6, by-laws were approved, Edward Kelley was elected Treasurer and Robert Dubreuil was appointed ublicity Chairman.

On May 11, P. J. Wood of the Royce Chemical Co. spoke on "Reducing Agents and Their Uses," showing experiments with Discolite, Vatrolite and Parolite. There were forty-five present, including graduates, and guests from the New Bedford Textile Institute.

Respectfully submitted,
Clyde Newland, *Secretary.*

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Meeting Dates, WNE Section

THE following tentative dates have been selected for meetings of the Western New England Section for the 1948-49 season:

September 10, 1948, October 29, 1948, December 4, 1948, January 15, 1949, February 26, 1949, April 8, 1949, May 20, 1949.

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CALENDAR

PHILADELPHIA SECTION
Meetings: September 24, November 12, January 28, 1949 (Kugler's, Philadelphia).

NORTHERN NEW ENGLAND SECTION
Meetings: September 24 (Andover Country Club); November 19.

SOUTHEASTERN SECTION
Meetings: July 24 (Atlanta, Ga.); September 25 (Columbus, Ga.); December 4 (Atlanta, Ga.).

WESTERN NEW ENGLAND SECTION
Meetings: September 10, October 29, December 4, January 15, 1949, February 26, April 8, May 20.

SUB-COMMITTEES
Meetings: September 16 (New York).

COUNCIL
Meeting: September 17 (New York).

RESEARCH COMMITTEE
Meeting: September 17 (New York).

NATIONAL CONVENTION
October 21-23 (Sheraton Bon Air Hotel, Augusta, Ga.).

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EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information from the Secretary.

48-1

Education: B.S. Rhode Island State College.
Experience: Chemist, print works.
Age 33; married; references; position in New England desired.

48-6

Education: B.A. University of Pennsylvania, with graduate study.
Experience: Fifteen years, wool scouring, carbonizing, bleaching; synthesis of wetting agents, detergents, textile oils and sizes; shrink proofing, waterproofing, mildew proofing.
Age 36; married.

48-7

Education: Technical school, with additional college courses.
Experience: Textile chemist, with practical experience in dyeing and finishing of cotton and rayon, including resin finishes. Textile Technologist, U. S. Quartermaster Corps, during war. Good knowledge of Spanish and Portugese.
Age 26; married; references; will work anywhere.

48-8

Education: B.A., New York University.
Experience: 19 years, textile chemical laboratory.
Age 39; married; references; vicinity of New York City preferred.

All Correspondence Concerning the Employment Register Should Be Directed to the National Secretary

Selection of Dyes and Dyeing Procedures for Viscose Rayon Cake Dyeing*

J. A. WOODRUFF
Textile Research Dept.
American Viscose Corporation

TO the majority present here, the subject of viscose rayon cake dyeing is of interest, but at the same time not part of their actual dyeing experience. For this reason it is felt that a brief introduction should be made, to explain some of the properties of a viscose rayon cake and to compare cake dyeing with the more familiar skein dyeing operations. Rather than repeat the two words "viscose" and "rayon", the word "rayon" alone will be used from here on. At this point, may I say that any resemblance to the definition of rayon as used here to that used by other rayon producers or by the U. S. government is purely coincidental.

In manufacturing rayon by pot spinning, a cake is formed by the yarn after it is carried away from the spinneret in the spinning bath. Shortly after leaving the spinning bath, the yarn is led down through a funnel and enters a rotating cylinder or spinning pot. Centrifugal force pulls the yarn from the lower end of the funnel out to the wall of the pot. During several hours of collection of yarn, a cake is formed inward from the wall of the spinning pot. In order to collect the yarn in an orderly mass, the delivery funnel moves up and down within the rotating pot to produce a definite angle of wind in the yarn. The yarn travels around in the pot approximately two times from top to bottom of the cake.

This is the resultant cake ready for delivery after having gone through normal processing. This paper covering serves for protection of the filaments during manufacturing processing and later in cake dyeing or other processes. It is a special paper having good wet and dry strength as well as excellent permeability to liquids and air. The permeability to dye liquor of the walls of the cakes themselves has been determined for a 1.1 lb. cake of 300 denier, 44 filament, as allowing passage of 1.5 to 3.0 liters of liquor per minute at a gauge pressure of 10 lbs. and at a temperature of 205° F. At 80° F., approximately ½ of this flow will be obtained with the same pressure of 10 lbs. 15 lbs. pressure would be required to maintain the same flow at 80° F. as would be obtained by 10 lb. pressure at 205° F. The cakes were mounted for these determinations in a manner which reduced to a minimum the amount of by-passing of liquor.

This cake may be dyed, a finish applied, then extracted, dried and wound directly to spools or cones. From cake as received to dyed yarn on a package ready for further use, only one winding operation is necessary.

Turning to skein dyeing, it is first necessary to make the skeins from cakes. Normally, two skeins are made from each cake. These skeins may now be dyed, a finish applied, then extracted, dried and wound to spools. If cones are desired, then the yarn is wound from spools to cones. Thus we have one winding for dyed cake yarn and two or three winding operations for skein-dyed yarn. At present prices for skein winding, the extra handling is a decided handicap to skein dyeing. Beyond the extra cost is the fact that cake-dyed yarn is in better shape for further use, having fewer knots and showing less handling damage. In partial cost compensation, it is acknowledged that cakes take longer than skeins in the dyeing and drying operations.

It is not necessary for me to give figures on the actual costs of yarn dyed in the cake in comparison with yarn dyed in the skein. Such figures can be obtained in the trade. The growing interest in expansion of cake dyeing is the best barometer available.

With this introduction to rayon cakes, the dyer is brought to the question of what machine to use to dye the cakes. The development of cake dyeing machinery was discussed by the speaker in an October, 1947, issue of the DYESTUFF REPORTER. Therefore only a short reference will be made here to the machinery used. What is necessary is a means of mounting the cakes within a machine which allows two or more liters of dye liquor per minute to flow evenly through the walls of each cake. This sounds simple. Cakes, when properly mounted, can be dyed successfully on practically any pressure dyeing machine capable of giving sufficient liquor flow. One-way flow from inside to out is adequate for direct dyes. Theoretically two-way flow should help to decrease the time required for good cake dyeing. In actual practice two-way flow has shown no great advantage and at the same time has been a source of distorted and blown cakes. Liquor pressures up to forty pounds have been used although ten to twenty-five pounds is more general. The allowable pressure depends on how the cake is mounted. When the cake is well supported the pressures can be high, but if poorly supported, blowouts or distorted cakes will occur at very low pressures. The mounting will also determine whether or not two-way flow can be used.

One type of cake holder is the Reno & Dougherty holder, Patent No. U. S. 2,431,-280, which has worked well at high pressures with practically no blowouts. It is felt that the curve on the inside supporting shoulder gives a firm seal with a fairly wide range of cake sizes, and tends to prevent excess by-passing of the dye liquor between the cake cover and the contacting metal. A different type holder has been made by Standard Fabricators, Inc. and has been in use in production for cake dyeing for some years. Still other cake holders have been developed and some have been described in the literature, but at the present date, these two types are the only holders known to be manufactured for use in the U. S. trade. These holders are designed for best operation with cakes weighing approximately 1.1 lbs. each. Such a cake weight gives the dyer a reasonable chance for success with the majority of direct dyes. In this country direct dyes only are used, and 300 or 150 denier are practically the only deniers so dyed.

Let us assume that a dyeing machine and the type holder have been decided

* Presented at meeting, New York Section, March 12, 1948.

upon. The next problem is to reason out what dyeing technique should be used and what direct dyes to choose. From a practical standpoint of experience on viscose rayon skein dyeing, or spun rayon package dyeing, a choice of dyes can be made. However, cake dyeing is more exacting and sensitive to poorly selected dye combinations. To the speaker's knowledge, there are no manufacturer's shade cards which attempt to supply information concerning cake dyeing selection. In order to form a background for such selection, testing procedures have been developed.

Turning to the literature, it will be found that considerable data on dye selection has been published in England, and one of the most important contributors is our guest, John Boulton. The lists of dyes examined in England are not easily translated into the American counterparts and since seeing is believing to most of us, it is necessary to do a great deal of the work over again.

Fortunately there are available several articles on test methods for dye selection. The report of committee of the Society of Dyers & Colourists formed to discuss the Dyeing Properties of Direct Cotton Dyes covers the field quite well.

Experience here and abroad has established that three application techniques of cake dyeing are sufficient to allow the use of a wide range of dyes.

Method I. Certain dyes do a satisfactory job when dyed for one to three hours without added salt, or very little added salt, at a temperature as close to 212° F. as can be circulated. It is sometimes necessary to lower the temperature at the end of the dyeing cycle, in order to obtain sufficient exhaustion, if salt is not used.

Method II. Other dyes are applied by dyeing at the highest obtainable temperature, and after ½ to ¾ hour, adding sufficient salt in graduated amounts to obtain the necessary exhaustion.

Method III. Still other dyes are applied by starting at temperatures from 90 to 130° F. and raising to the highest obtainable temperature in approximately one hour, then continuing with the salt addition technique of Method II.

It is not difficult to visualize the types of dyes whose characteristics best suit such application methods. For use with Method I are dyes such as C.I. #278 (Red 8BL) which exhaust in low volume ratio without added salt, and which are capable of leveling very readily at high temperatures even when originally applied unevenly.

For use with Method II is a large group of dyes typified by Sky Blue FF, C.I. #518, which have negligible exhaustion without added salt, and therefore can be called salt controllable in their exhaustion. They do not level readily even at high temperatures, when compared to the dyes which work with Method I.

Method III applies to dyes such as Chlorantine F. Brown BRL, Pr. #47, which exhaust quite rapidly without added salt when dyed at high temperatures, and whose exhaustion is further increased by added salt. Like the dyes used with Method II, these dyes do not level readily even at high temperatures. Roughly, the classifications listed here are those of the Class "A", "B", and "C" dyes first grouped by C. M. Whittaker.

Level dyeing is a loose expression which must be defined to have meaning. The term as used here implies an over-all even distribution of dye, obtained by techniques normal to the dyeing machine and to the material being dyed. A dye which is found to give very level results on piece goods may be extremely poor for cake dyeing. Level dyeing may be obtained by giving each fiber of the material dyed an equal time of contact with an equivalent concentration of dye liquor. Many times it is not possible to fulfill these conditions and to obtain levelling; the absorbed dye particles must have the ability to return to the dye liquor in part, to be re-absorbed at a new site containing fewer dye particles. This is a dominant characteristic of Class "A" dye leveling. Yet this is not the complete story. Class "A" dyes can actually penetrate a dense mass of fibers much more quickly than Class "B" or "C" dyes. As an illustration, tie a knot in a small skein of viscose yarn and drop it in a hot salted dye bath containing a mixture of Red 8BL, Class "A", and Sky Blue FF, Class "B". After five minutes dyeing, remove the skein and you will find that the yarn in the knot, where dyed at all, has a definite red cast compared with the shade of the loose yarn. To the speaker this means that the Red 8BL has more freedom of movement than has Sky Blue FF, when both are surrounded by the attractive substantive forces of viscose. As in any form of package dyeing, leveling on cakes can best be accomplished by obtaining the maximum even flow of dye liquor through all parts of the package.

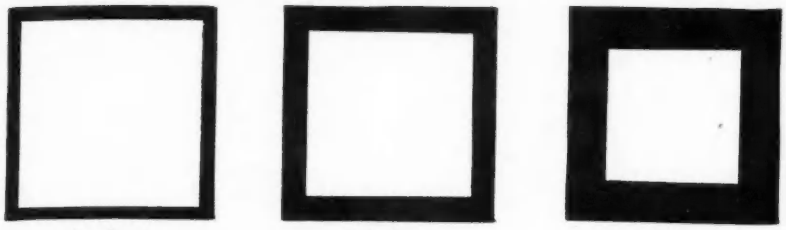
As mentioned before, the English workers have devised test methods for determining which dyes fit the Methods I, II, and III. While not broadly disagreeing with their findings or test methods, some different approaches seemed to offer short cuts and possibly more easily applied information.

The tools which have been developed here for observing some of the dyeing characteristics are solid blocks of water-swollen viscose. These blocks are cut from slabs prepared by setting spinning age viscose solution by heat, then washing the slab until quite clean and white. The slabs are then stored in distilled water so as to retain the highly water-swollen condition. From these slabs, blocks are cut approximately ⅝ x ⅝ x 2″ and placed in water solutions of single dyes with and without salt. The blocks weigh approximately five grams each, including contained water, and are dyed in 150 ml. volume of water. After dyeing for one hour at the boil, a portion of the block is cut and the distance penetrated by the dye is measured with a steel rule in 64ths of an inch. A wide field microscope of low magnification is used for viewing. The dyeings are continued for six hours and new samples are cut and measured at each hour. The results obtained are called "diffusion penetration" measurements. With each group of dyeings, Sky Blue FF has been run as a control and the reproducibility has been very good.

Figures 1, 2, and 3 illustrate the appearance of these dyed blocks of viscose. Figure 1 is an enlargement of the dyeings of Sky Blue FF. The first square represents the first hour of dyeing with a measurement of 2/64″. The second square represents the sample cut after three hours dyeing time and the third square represents six hours' dyeing time with a final diffusion penetration of 7/64″. Figure 2 represents the dyeings of the blocks with Red 8BL for one, three, and six hours dyeing and represents complete penetration or approximately 12/64″ in the sixth hour. When the undyed area becomes very small, the measurements become difficult and a thicker block would be needed for accurate measurements. Figure 3 represents the squares dyed with Fastusol Grey LRA in the first, third and sixth hours. The diffusion penetration here is quite low compared with either the blue or the red.

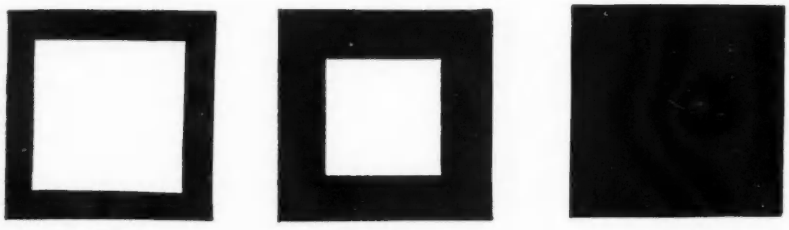
It has been found that those dyes which without salt penetrate more than 9/64″ into the blocks in six hours are the dyes for use with Method I. The dyes for use with Methods II and III are mixed with "diffusion penetrations" from 1/64″ to 10/64″ in six hours. It is interesting to note that Turquoise 8GL, Pr. #278, is in a class all by itself with a diffusion penetration greater than 12/64″ in one hour's dyeing. No other dye yet tested comes close to this.

The effect of added salt generally shows a decrease in the diffusion penetration measurement. Very little information has been derived from the results obtained on



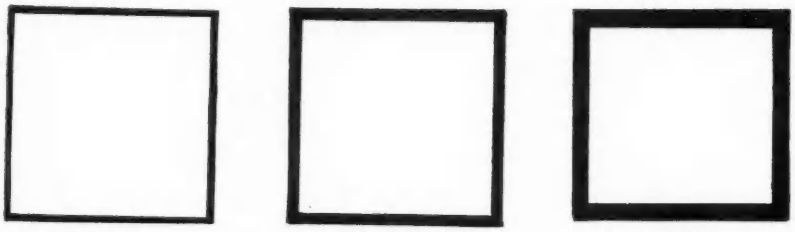
1st hour 3rd hour 6th hour

Figure 1
Sky Blue FF



1st hour 3rd hour 6th hour

Figure 2
Red 8 BL



1st hour 3rd hour 6th hour

Figure 3
Fastusol Grey LRA

diffusion penetration measurements in the presence of salt, beyond the realization of its different degree of effect on different dyes. In six hours dyeing of the blocks with 10% salt present, a decrease in penetration is noted which varies from 0 change to ½ the penetration of dyeing without salt. Without exception, the Class "A" dyes are seen to be slowed considerable by salt addition.

The temperature of dyeing has a large effect upon "diffusion penetration". In all cases tested, the ability of the dyes to penetrate is increased considerably with increased temperatures. Numerically in 64ths of an inch measurements, the Class "A" dyes show much the greater increase than those of Class "B" or "C". The percentage increase in penetration, however, appears to be similar for all dyes. The diffusion penetration at 160° F. is about 50% of that obtained at 212° F.

The effect of increasing the dye concentration in the dye liquor, within the normal range of dyeing concentrations, is to increase the "diffusion penetration". Decreasing the volume of the dye liquor, while keeping the amount of viscose present constant, will also cause an increase in penetration.

From the "diffusion penetration" measurements, those dyes having Class "A" possibilities are separated from those of Classes "B" and "C". Also quite a few dyes having very low "diffusion penetration" are noted, in order that they be recommended only when a high rate of flow of dye liquor can be maintained through the cake walls. A third result is that the presence of dye mixtures sold as a single dye is very often disclosed by unequal penetrations of the two components.

In order to differentiate between the Class "B" and "C" dyes, the next step is to determine the rate and degree of exhaustion of each dye in the presence and absence of salt. To do this, swatches of spun viscose fabric have been cut from a single piece and dyed for periods of 5 minutes, 15 minutes, and 45 minutes at 200° F. These three dyeings are done first in distilled water plus a wetting and dispersing agent and dye. The second set is done in similar baths plus 10% common salt. The degree of exhaustion is computed from spectrophotometric transmission curves of the original dye liquors and the exhaust liquors. It is felt that the measurement of the dye remaining in the exhaustion bath is sufficiently accurate unless a shift in the wave length of maximum absorption indicates the presence of non-exhausting impurities.

The Class "A" dyes have been indicated by their high "diffusion penetration". The exhaustion tests in 50:1 volume ratio show them to have from 3 to 8% exhaustion without salt and a moderate 45 to 70% exhaustion in 45 minutes with salt. The Class "B" and "C" dyes are differentiated by their exhaustion behavior without salt. Those dyes showing less than 3% exhaustion without salt are definitely salt controllable and belong in Class "B". The exhaustion of these same dyes in 45 minutes with 10% salt added will vary from 55 to 90%. The Class "B" dyes show "diffusion penetration" measurements from 2 to 9/64″ in six hours dyeing. The Class "C" dyes show greater than 10% exhaustion without salt, and require temperature control as well as salt control for application. These dyes show rather high exhaustion in 45 minutes when dyed with salt. This exhaustion varies from 80 to 97%. The "C" in Class "C" may stand for "consternation" or "condemnation" since these dyes are not often used in cake dyeing. The Method III procedure of dyeing can be used with temperature control, but in most cases the increased time of dyeing thus brought about is not worth the gain of increasing the number of dyes usable.

The easiest dyes to apply to cakes in light to medium shades are the Class "A" dyes. Because of their leveling and penetrating characteristics, they are also the least fast to bleeding. The majority of the dyes of better fastness to washing, bleeding, perspiration, and incidentally to light, fall in Class "B". It is in this class that the greatest interest lies. Single dyes of this class or any other class are not difficult to apply to cakes; it is in choosing combinations that skill must be employed. The exhaustion tests show which dyes within the Class "B" limits should be used together. Obviously, those with 45 minutes exhaustion figures which are widely different should not be mixed unless the dyeing is to be run to complete exhaustion. It makes for difficult matching and is time-consuming, when the salt control has to be designed sufficiently weak to

apply a fast exhausting dye evenly, and then more salt be added to exhaust the second component properly.

To date, no Class "B" combinations have shown unpredictable compatability behavior. The prediction of Class "A" behavior has also been quite successful. The same cannot be said for quite a few borderline dyes which appear to exhibit characteristics resembling both Class "A" and Class "C", and for Class "B" dyes having widely different exhaustion values. There is no doubt but what at least two sub-divisions of each Class "A, B, and C" can be made which would place the borderline cases in more proper classification. The prediction of behavior of mixtures of representative class "A" and "B" dyes has met with fair success when the method of application is controlled to compensate for the different behaviors.

Assuming that the method of application has been established, what is the best way to test combinations for compatability? Once again, tests on fabric and skeins such as "strike" tests of the combinations should show how the individual dyes will act in combination. Unfortunately these tests on fabric, or skeins in beakers, do not represent cake dyeing conditions. It has been mentioned by others that the effective ratio of dye liquor to fiber being dyed is approximately 3 to 1 in package dyeing, when measured within the package. Strike tests on skeins have been practical only in much higher volume ratios. Therefore it was decided to run the compatability trials under actual cake dyeing conditions on a single cake machine. This machine is extremely simple. A single round flat plate is pierced in the center to admit a dye liquor delivery pipe. The cake rests on this plate around the pipe, and a second plate presses down on the cake from above. The distance between the plates can be adjusted to any desired height. Now liquor is pumped up inside the cake and flows through the cake walls out into a surrounding trough, then on to an expansion tank and back to the pump for re-circulation. A by-pass piping arrangement permits controlled pressures, and the rate of flow is easily determined by inserting a beaker at the foot of the overflow trough for measuring the amount of liquor coming through in a set period of time. The unit is simple, compact and inexpensive. The cake is in view at all times; the dyeings obtained are very good and have been shown typical of full scale machine dyeing. As an illustration of the efficiency of dyeing conditions, this fabric has been brought along for display. The yarns contained here in the warp and filling were gathered from 28 cakes. Each cake was dyed alone in a two-hour dyeing on the single cake dyeing machine described. In three or four of these dyeings minor operator troubles caused slight changes in dyeing procedures, yet the resultant fabric compares very well with skein-dyed yarn from combined dye lots.

When a combination of dyes has been selected for expected desirable characteristics, a cake is dyed on this single unit machine to determine the usefulness of the combination. Obvious failures are easily spotted in the dyed cake. A cake which appears to have been dyed with good results is wound in part on three cones. One part cone is made from the extreme outside of the cake, another of the yarn midway in the cake, and a third from the very inside of the cake. Knittings are then made on a single end machine to bring out possible defects.

In summation, tests for dye selection for cake dyeing methods of application have been utilized in testing a considerable number of direct dyes. The application of the results has been sufficiently interesting to warrant further work and publication of the data obtained. At the present date, over 110 dyes have been tested for diffusion penetration and for their exhaustion rates. A smaller number has been tested for compatability in cake dyeing. Rather than show lists of the dye characteristics this evening, it was decided to wait until the compatability tests have been somewhat enlarged, when the information compiled will be released. It is hoped that the publication of this data will aid those dyeing viscose rayon with direct dyes, as well as encourage further investigation of the properties of dyes in general.

Progress in the Application of Vat Dyes to Viscose Rayon Cakes*

JOHN BOULTON
Research Manager of Courtaulds, Ltd., Droylsden, England

BEFORE I begin with the substance of what I have to say, I would like, first, to convey to the American Association of Textile Chemists and Colorists the warm greetings of the Society of Dyers and Colourists. Secondly, I should like to say how deeply honored I am that your Chairman should ask me to speak tonight. So I think the least I can do is to keep to the subject; we will carry on with cake dyeing.

Mr. Woodruff has told us that the difficulties of applying direct dyes to rayon cakes increase as we apply the fast to washing direct dyes. Using the classification of the Society of Dyers & Colourists, this means that Class A, the easily leveling type are relatively simple of application, Class B, the difficulty leveling type whose exhaustion is controllable by salt additions are more difficult and Class C, which require both temperature control and controlled salt addition are the most difficult. It is in the nature of dye- diffusion that the slowly leveling types shall be the most fast to washing.

What I have first to say about vat dyes on viscose rayon cakes is, in principle, an extension of what has been said about direct dyes. Vat dyes are more difficult to apply than are Class C directs, not because they are qualitatively different but essentially because leuco vat dyes behave very much like highly salt sensitive Class C directs, but go further in the direction of (a) high rate of exhaustion, (b) slow leveling.

* Presented at meetings of New York and Northern New England Section.

In short, vat dyes in solution in the leuco form are colloid electrolytes; like direct dyes, they have a very high exhaustion rate but once on the fiber surface they penetrate very slowly because they have, relative to direct dyes, a low diffusion rate.

In dealing with vat dyes on rayon cakes we will be helped by an understanding of those same principles which we have applied to direct dyes.

TEMPERATURE.—Leveling and penetration depend upon diffusion of dye inside the fiber. This property is greatly affected by heat and the higher the temperature of dyeing with leuco vat dye, the better, for that reason.

There are limits to the temperature one can employ with vat dyes; but one can go some distance in making use of temperatures higher than those traditionally used and we have classified those dyes in use on viscose rayon according to optimum temperature as follows:—

Strong Alkali Dyes: Dyed at 35°-60° C.

Paradone Yellow G.
Paradone Yellow GC.
Caledon Yellow GN.
Cibanone Yellow GN.
Cibanone Yellow GC.
Tinon Chlorine Yellow RG.
Sandothrene Yellow NGN.
Sandothrene Yellow NGC.
Caledon Brilliant Orange 4R.
Caledon Brilliant Purple 4R.
Tinon Chlorine Violet B4R.
Sandothrene Violet N4R.
Caledon Navy Blue 2RS.
Alizanthrene Navy Blue R.
Paradone Dark Blue.
Paradone Black 2B.
Caledon Blue R.
Cibanone Blue RSN.
Tinon Chlorine Blue RSN.
Sandothrene Blue NRSN.
Caledon Blue RC.
Paradone Blue RC.
Caledon Green RC
Caledon Olive Green B.
Cibanone Olive 2B.
Tinon Chlorine Olive 2B.
Sandothrene Olive 2B.
Caledon Jade Green XNS.
Paradone Jade Green XS.
Sandothrene Green XS.

Weak Alkali Dyes: Dyed at 35°-60°C.

Caledon Red BN.
Cibanone Red RK.
Tinon Red RK.
Sandothrene Red N2R.
Caledon Pink RL.
Caledon Red X5BS.
Caledon Red Violet 2RNS.
Caledon Brilliant Violet RS.
Caledon Brilliant Violet 2B.

Weak Alkali Dyes: Dyed at 35°-60° C. *or* at 80° C.

Caledon Golden Orange 3G.
Caledon Brown 3G.
Caledon Brown G.
Paradone Brown G.
Cibanone Brown BG.
Caledon Brown R.
Paradone Brown R.
Caledon Olive R.
Cibanone Olive 2R.
Paradone Olive R.
Tinon Chlorine Olive 2R.
Sandothrene Olive N2R.
Caledon Red 2G.
Sandothrene Red L2G.
Paradone Red Brown 2RD.
Paradone Red Brown 5RD.
Paradone Yellow 5GK.

Using direct or vat dyes with viscose rayon in *any* form it pays to get maximum diffusion rate in so far as this can be influenced by temperature.

EXHAUSTION RATE: RESTAINING AGENTS.—The rate of exhaustion, or "strike" especially of the strong alkali types, is very much higher for vat dyes as a class than for directs. And this rate cannot, as with directs, be controlled by salt addition because the presence of caustic soda and hydrosulfite means that there is, at the outset, a very high electrolytic content in the bath. Consequently, it is common to think in terms of "restraining agents" for vat dyes.

Many substances have been proposed to serve this function. A satisfactory restrainer in theory, must be some agent which will

(a) compete with fiber for the dye molecules,

(b) have an affinity for dye such that dye molecules can be transferred from the restrainer to the fiber and not be permanently removed from the dyeing system.

These conditions are met by cellulose sulfite waste liquor, to a useful degree.

The active component is lignin sulfonic acid. Some liquors containing this agent work well as restrainers and some work less well. T. H. Morton of Courtaulds discovered why this was so; cellulose sulfite waste liquors work well only if they contain magnesium. The actual restraining agent is magnesium lignin sulfonate. This has the power, not possessed by the sodium salt, of forming a complex with the leuco dye which exists, alongside the cellulose to be dyed, in a state of dynamic equilibrium. This complex cannot, because of its molecular dimensions, act as a dye but, as dye molecules are taken up by the fiber it breaks down to produce more free leuco dye molecules and these are progressively taken up by the fiber in turn.

Consequently we employ a small addition of Epsom salt to make sure that the cellulose sulfite waste liquor can contribute magnesium lignin sulfonate to the dyebath. Typical additions are 6% of cellulose sulfite waste liquor and 2% of Epsom salt on yarn weight.

PIGMENT PADDING.—The advances made in the U. S. A. in piece dyeing with vat dye depend upon the use of highly dispersed oxidized dye which is distributed on the piece as a pigment in suspension, reduced *in situ* and dyed in high temperature steam.

This is another method of restraining "strike": the dye is distributed in non-diffusible form and dyeing proper is only permitted to take place after even distribution of dye particles. This distribution by padding on to a flat fabric has been reduced to a relatively simple technique. But the distribution through a thick cake of viscose rayon is a different matter and must depend upon (1) very fine dispersion of vat dye so that the particles are not filtered out during liquor circulation and (2) some means of "salting on" the dye particles.

Progress has been made in this direction by the "Abbot-Cox" method of Imperial Chemicals Dyestuffs Division. The difficulty is that any known dispersing agent is not universal in its application. The optimum concentration for one dye might be very different from that required by another, so that the dyeing of mixings is not readily possible. A "universal" dispersing agent is required. However, working with the ethylene-oxide fatty alcohol condensate of Messrs. Imperial Chemical Industries, a good deal of progress has been made and we have worked out the technique of dyeing, e.g. wound, "mock" cakes of "Fibro" as big as the one here on view, which was dyed with vats on a Longclose type machine by a pigment padding technique of which I have given details elsewhere.

DYE DIFFUSION: LEVELING. — Restraining the exhaustion rate is only one part of the answer to vat cake dyeing. This must be followed by maximum aid to leveling. For that reason, as we have seen, maximum permissible dyeing temperatures should be used. There is a further available influence: i.e. the state of dye in solution. We know from work with direct dyes that some solvents, such as pyridine and Cellosolve increase the diffusion rate of dyes in fiber, as a conse-

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Water Resistant Fabric Treatments*

RAYMOND A. PINGREE
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A PERSON who has never seen a water resistant fabric might think it unreasonable to expect a fabric filled with holes to be impervious to rain. It can be made so, of course, to a remarkable degree. In order that it may function as a water resistant fabric, the holes, or interstices, must be smaller than a raindrop, and the fiber surfaces must possess high interfacial tension against water so that they do not wet. The drop, therefore, must either lie on the surface of the fabric or roll off. Most textile fibers are hydrophylic in character, and must be coated with a protective film to provide the hydrophobic surface required. There are many film-forming substances which possess this characteristic to some degree. Of these many are highly colored, and therefore of little value in the textile field. Even though we still have many materials to choose from, not one has yet been found which meets all requirements for a perfect water resistant finish. The term water resistant, in reference to present fabrics, is still relative.

There are several semi-quantitative methods for measuring water resistance of fabrics, the best known of which is the Spray Rating test. It is simple, rapid and useful. A spray rating of 100 is considered excellent water repellency. As effective water repellent treatments are developed and we become more exacting in our requirements, this test will not be adequate.

During the war the Quartermaster Corps, in cooperation with others, devised the Dynamic Absorption and Drop Penetration tests. These afford more quantitative measurements of water resistance than the Spray Test, but are more involved and time consuming, hence are not as useful for control work.

Recently the committee on water repellent fabrics of the AATCC recommended the Raintester. This may be considered a refined Spray Tester in which flow through the spray nozzle may be varied to compensate for differences in water resistance of fabrics. The weight of water passing through the fabric is measured, giving a quantitative value. This test is fairly simple and rapid. When more laboratories have the equipment it may find general acceptance.

Regardless of the test method used, we are still measuring a value relative to arbitrary standards, based on optimum results with existing fabrics and treatments.

We have not yet produced a completely water resistant fabric, and probably never will, but we are likely to approach perfection more closely than we are now doing. The water resistance of a fabric is dependent to a great extent upon fiber and fabric construction. It is possible to construct two fabrics of the same general type and weight, which after treatment exhibit the same degree of air permeability, but an enormous difference in water resistance. In spite of superior construction, the better fabric will not serve much better than cheesecloth against rain unless properly treated with the correct type of water repellent. The object of treatment is to deposit a water protective film about each fiber without materially altering the size of fabric interstices or adversely affecting physical characteristics. To perform this feat with any given fabric it is necessary to observe certain fundamental practices.

First, and not of least importance, the fabric must be properly prepared to accept water resistant treatment. The fiber surfaces must be free from impurities. It is common practice to test fabric pH and absorbency. This does not tell the whole story. Although pH may be within proper limits and absorbency excellent, the fabric may still contain appreciable quantities of water soluble salts and insoluble pigment materials which can affect the treatment. Water soluble salts not only affect the quality of water resistant treatment, but may so build up in the impregnating bath as to disturb emulsion balance, causing gradual separation of the active constituents. Insoluble pigment deposit on the fibers is often caused by improper dyeing with pigment forming colors such as naphthols, sulfurs and vats. If proper penetration is not obtained during dyeing, a portion of the precipitated color may be loosely attached to the fiber surface. This forms an effective barrier to penetration and bonding of water repellent material. The same condition sometimes results from deposition of insoluble chromium compounds during chrome and acetic acid oxidation of vat colors. Proper processing techniques designed to avoid these difficulties are obvious to all acquainted with dyeing processes.

Assuming that we have a truly clean fabric, our next decision lies in choice of the proper water repellent. Textile fabrics seem to possess peculiar personalities. They have their likes and dislikes in water repellents. Viscose rayon fabric may get along beautifully with a given water repellent with which cotton may not wish to associate, and an acetate fabric may get along agreeably with a water repellent which neither cotton nor viscose rayon will tolerate. Therefore it is well to choose carefully the type best suited to the fabric.

The third requisite for proper treatment is that the water repellent bath be prepared according to best practice and that optimum conditions of application be observed. Preparation of the bath may proceed according to the manufacturer's instructions and will of course vary with types of material. Regardless of the type of compound used, optimum results can be obtained only when complete penetration of the fabric is obtained. This is easily achieved by use of a three-bowl padder, or by passing goods through a two to four dip immersion box in front of the padder. A heavy nip also is preferable, aiding materially in driving water repellent into the fabric between individual fibers. Drying conditions and subsequent operations are governed by the type of compound applied.

Until about fifteen years ago, water resistant treatments were accomplished by a two step process in which a film of aluminum or lead soap was deposited on the fabric. At the present time treatment is usually accomplished in a single step.

* Presented at meeting, Piedmont Section, April 3, 1948.

Aluminum and lead soaps play but a minor roll.

All of the commonly employed water resistant treatments owe their useful performance to the mechanical deposition of hydrophobic films on or near fiber surfaces. Many researchers are of the opinion that the ideal water resistant finish must be accomplished by chemical modification of the fiber surface. This may or may not be true. At the present time, however, we have little evidence that any of the commercially proven water resistant treatments involve chemical reaction with the fiber. Probably the nearest approach is a process of subjecting fabric to the vapors of an alkyl chlorosilane, which reacts with available hydroxyl groups to form a water impervious film of polyalkylsiloxane. Even this may not involve reaction with the cellulosic fiber, but with hydroxyl groups in the absorbed moisture on fiber surfaces. This process has not yet proved practical for fabric finishing.

Water repellent compounds may be divided roughly into two classes, durable or renewable, indicating resistance or lack of resistance to laundering and dry cleansing. The renewable type usually consists of an aqueous emulsion, containing waxes in the dispersed phase, and a solution of aluminum salts, emulsifying agents and protective colloids in the continuous phase. Applied in the emulsion to fabric the water soluble aluminum salts penetrate the fiber, and as the fabric dries they hydrolyze to form aluminum hydroxide which finally dehydrates to oxide. This oxide deposit forms mostly at the fiber surfaces, and beside contributing its inherent water resistant characteristics, aids in bonding the wax film subsequently formed. This double effect serves its purpose well, but only on water permeable fibers such as cotton, regenerated cellulose, wool and linen. Water impermeable fibers such as cellulose acetate, nylon and vinyon are not particularly receptive to this treatment, because the aqueous aluminum salt solution cannot penetrate the fiber, and there is not effective bonding.

Renewable water repellent compounds of this type should be carefully formulated to provide optimum performance. The aluminum salts should be adjusted to insure formation of oxide under normal plant drying conditions. The emulsifiers and protective colloids should not injure the hydrophobic characteristics of the finish nor alter the hand of the fabric. The waxes must be carefully selected for film forming properties, toughness and stability at high temperatures. The emulsion must be properly balanced to minimize phase separation in storage and during application.

This type of water repellent is usually applied to the fabric at a temperature not less than 140° F., in concentrations ranging from 4 to 12%. It should be applied in such manner as to obtain good penetration of the fabric and dried at temperatures high enough to decompose the aluminum salts completely. The water repellency of the fabric will suffer from prolonged heating, for some unexplained reason, and it is therefore advisable to bring the goods off the drier as cool as possible. This is sometimes achieved by passing over a cold can or plaiting into boxes.

Before discussing the well known durable repellents, I would like to say a few words concerning a relatively new type of compound, which may be classed as durable or semi-durable depending upon the fabric to which applied. This material is usually supplied as two separate products. One is composed essentially of water soluble, polyvalent metal salts; the other is an emulsion of waxes in the dispersed phase, with a water solution of fatty acid salts and emulsifying agent in the continuous phase. The two products are diluted and mixed just prior to use. The result is a semi-colloidal dispersion of waxes and polyvalent metal soaps. This type of treatment is admirably suited to water impermeable fibers such as cellulose acetate, nylon and vinyon, and on these materials exhibits good durability. Water resistance is retained to a marked degree even after several launderings and dry cleanings. This compound is being applied successfully also to cotton and regenerated cellulose fabrics where it possesses durability intermediate between renewable and durable treatments.

The effectiveness of this type of water repellent depends upon the deposition of a homogenous mixture of waxes and metallic soaps, which complement each other to form a tough, flexible, water impervious film around the fibers.

Certain precautions must be observed in preparation of the treating bath to insure satisfactory performance. Normally the wax emulsion component is on the alkaline side, while the metal salt compound is on the acid side. In mixing there is a point where the emulsion is quite unstable, and coagulation may occur. To minimize this possibility the wax emulsion should first be diluted with almost the full quantity of water, at the temperature recommended by the manufacturer. The metal salt component should then be introduced rapidly in one addition. In this way the mixture passes through the unstable isoelectric state very rapidly and suffers no harm.

The polyvalent metal soaps and waxes exist as separate components in the bath. In applying to the fabric, drying temperatures must be sufficiently high to promote solution of the metallic soap particles in the molten wax as moisture is eliminated. Drying temperatures of 270° F. or higher have been found satisfactory. No additional heat treatment is required.

Durable water repellents first came into extensive use during the war, and their use on army fabrics lent impetus to research and development. The durable type repellents in use today are consequently much improved over those used during the early war years, and work is continuing in many laboratories on further improvements. The two repellents of this type which have proven most successful are based on fairly complex organic compounds. They are both long chain quaternary salts, and being cation active, exhibit considerable affinity toward negatively charged fabrics. One of these compounds is derived from methylol stearamide, the other from octadecane nitrile. The effectiveness of these compounds may be attributed to their unstable nature. Under the influence of heat they are decomposed into pyridine hydro halide and a water impervious residue which remains firmly attached to the fiber. It was first thought that the durability of these treatments was due to chemical reaction with the fiber. This assumption is not now generally accepted, as there is considerable evidence to indicate that very little reaction, if any, occurs. Affinity for cellulosic fibers, inert character of the residue, and good film forming properties probably account mainly for durability of these treatments. The treating bath, if properly prepared, will be a colloidal or semi-colloidal dispersion of pyridinium salt. Extremely small particle size promotes penetration of the dispersed material into the fiber. Optimum results cannot be obtained without complete penetration. It is therefore important that the bath be prepared in strict accordance with the manufacturer's instructions. As in all water repellent applications the padding equipment should provide ample time and sufficient squeeze to insure maximum penetration.

In drying this type of finish it is advisable to bring the goods off with a small moisture content to prevent premature curing. Thus it is easier to control the curing operation. Goods partially cured in the drier may be overcured in the curing chamber. This is often detrimental to the finish. If goods

entering the curing chamber contain an excessive amount of moisture they do not reach maximum temperature until all this moisture has been driven off, and consequently may be under-cured. It is considered best practice in both drying and curing operations to bring the goods off cool as possible.

Durable water repellent treatments in use today leave water soluble acidic residues in the cured fabric. If these are not removed, goods may be seriously tendered by acid and develop objectionable odors in storage. These impurities, being water soluble, are easily removed. This is accomplished by passing the fabric through a solution containing a small amount of a wetting agent to permit penetration of the water repellent cloth, and a little alkali to neutralize acidity. The wetting agent and alkali must then be removed completely by rinsing in water.

Aside from these two most commonly known durable water repellents, there is another type now meeting some success. This consists of an emulsion of hydrophobic substances such as stearamide derivatives and waxes, combined mechanically with a thermo-setting resin. These are applied to the fabric in much the same manner as the others. One of the principal objections to this type has been alteration in hand of the fabric. This has been overcome to a large extent.

There is still much room for improvement in durable water repellent treatments. Higher water resistance and greater durability are desirable. Elimination of expensive curing and after-washing is possible. Extensive research is in progress toward these goals and before many months they may be attained.

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Viscose Rayon Cakes—

(Concluded from Page P439)

quence of lowering the degree of aggregation of dye molecules.

The principle has been applied by us to vat dyeing, and we have found that a number of solvents as additions to the leuco bath have the power of aiding leveling in a striking way.

Good results have been obtained with dyebaths containing the following, in concentrations expressed on a volume basis:—

25% Industrial ethyl alcohol
10% Carbitol
4-5% Butyl Carbitol.

The use of these solvents is a matter, now, of economics. The high boiling carbitols are to be preferred; at present the price of butyl carbitol is prohibitive unless solvent recovery is employed. But, our work has shown that with the use of this type of water-organic solvent dyebath there is possible the controlled penetration of viscose cakes with even the most difficult of vat dyes.

Exhibited here is a cake of 60 denier 60 filament viscose. It is agreed, with direct or vat dyes, that the finer the filament denier, the more difficult the uniform dyeing of a cake. This cake is quite uniformly dyed, a result which was achieved in a laboratory Longclose machine using a combination of pigment padding and reduction in a bath containing 4% of butyl carbitol. We believe that this is the first time a cake of this fineness of denier has been dyed with Caledon Blue RC to give a commercial result. I am not suggesting that commercial weights of this type of yarn can be dyed with any vat dye or combination of vat dyes in the works with no fear of failure. But I am stating, with a demonstration of the result, that a vat blue on a fine denier cake is possible, to a degree of levelness which has not been possible in the absence of the dyeing modifications here discussed.

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William T. Corn—Pres., Mfg. Soap & Chemical Co., Cleveland, Tenn. Sponsor: J. A. Watt.

Earle C. Crompton—Salesman, Textile Products Co., Inc., Providence, R. I.

J. Glenn Freedy—Chemist, Joseph Bancroft & Sons Co., Wilmington, Del. Sponsors: A. L. Lippert, F. M. Ford.

Henry R. Husbebeck—Chemist, Joseph Bancroft Sons, Wilmington, Del. Sponsors: A. L. Lippert, W. P. Hall.

Nils W. Janson—Res. Dept., Princeton Knitting Mills, Inc., Watertown, Conn. Sponsors: R. C. Geering, E. N. Young.

Robert R. King, III—Textile Engr., Cone Finishing Co., Haw River, N. C. Sponsor: F. A. Whitney.

John S. Olesin—Colorist, Ablest Screen Printing, Inc., Brooklyn, N. Y. Sponsors: H. M. Friedman, F. Kiviat.

Mayashanker P. Pattani — Distributor, Maya Shanker P. Pattani, Bombay, India.

Jules L. Pinte—Diretcor, Centre de Recherches de la Soierie, Lyon, France.

George C. Ramey—Adv. Mgr., American Cyanamid Co., New York, N. Y.

Henry M. Rubin—Salesman, Richmond Oil Soap & Chemical Co., Philadelphia, Pa. Sponsors: W. Alkus, M. W. Levi.

Wendell F. Simmons—Dist. Sales Mgr., Blaw-Knox Co., Philadelphia, Pa.

Nicolas H. Van Heek—Managing Dir., N. V. Gebr. s. VAN HEEK, Enschede, Holland. Sponsor: W. E. P. VanOordt.

William B. Whiteburst—Supt., Burlington Mills Corp., Havana, Cuba.

STUDENT

Luther W. Armstrong—Clemson College, Sponsor: J. Lindsay, Jr.

Richard C. Ellison—Clemson College, Sponsor: J. Lindsay, Jr.

Herman E. Lawrence, Jr.—Clemson College. Sponsor: J. Lindsay, Jr.

Benjamin L. Powers—Clemson College. Sponsor: J. Lindsay, Jr.

Clinton W. Riser—Clemson College. Sponsor: J. Lindsay, Jr.

Joe E. Spearmen—Clemson College. Sponsor: J. Lindsay, Jr.

John M. Withington—Clemson College. Sponsor: J. Lindsay, Jr.

Robert S. Brooks—Georgia School of Technology. Sponsor: C. A. Jones.

William I. Head—Georgia School of Technology. Sponsor: C. A. Jones.

Edwin J. Greene—North Carolina State College. Sponsor: H. A. Rutherford.

James J. West—North Carolina State College. Sponsor: A. H. Grimshaw.

Herbert F. Ross—Rhode Island School of Design. Sponsor: H. B. Sturtevant.

Alberto Saltiel—Philadelphia Textile Institute. Sponsor: P. Theel.

Ramswarup G. Godiwala—Lowell Textile Institute. Sponsor: E. E. Fickett.

CORPORATE MEMBERSHIP

Associated Dyeing & Printing Co. of N. J., Inc., 25 Sixth Ave., Paterson, N. J.

Bates Manufacturing Co., P. O. Box 591, Lewiston, Maine.

Brandon Corp., Renfrew Bleachery, Travelers Rest, S. C.

The Clark Thread Company, Albany, Ga.

Applications for TRANSFER TO SENIOR MEMBERSHIP

Max Lane, Jeffrey J. Shapiro, G. Robert Turner.

Crockmeters and Crockmeter Cloth

Revised Prices

Regular Crockmeter	$20.00
Regular Crockmeter (with automatic counter)	30.00
Duplex Crockmeter	50.00
Crockmeter Squares (500)	1.50
Crockmeter Cloth (96 x 100), by the yard	.75

Available from the National Secretary:

Dr. H. C. Chapin
Lowell Textile Institute
Lowell, Mass.

Patent Digest—

(Continued from Page 432)

U. S. Pat. 2,226,162 (Mathieson Alkali Works): Bleaching is preceded by a treatment with 2-10% sodium hydroxide solution for 2-12 hours *before t*he proper boiling-off operation.

U. S. Pat. 2,220,682 (Buffalo El. Chem. Co.—Kauffmann): Textile fabrics are bleached by dampening the goods in a per-compound and heating thereupon.

Earlier work done for eliminating the kier boiling operation:

U. S. Pat. 2,048,991 (H. Th. Boehme): A combined hypochlorite-peroxide treatment is supposed to make a kier pretreatment dispensable. U. S. Pat. 2,037,119 of the Comey Brooklyn Company suggests impregnating the raw cloth with peroxide and passing it through a chamber filled with ammonia vapor. Ger. P. 570,022 (Gold-und Silberscheide-Anstalt) recommends preparing the goods with a reducing agent, followed by a hydrogen peroxide treatment. Here also a kier boiling process can be dispensed with.

Shrinkproofing Wool—Alkylating Process A, 2, 04

U. S. Pat. 2,434,562

(Textile Foundation, Washington, D. C., Milton Harris, Jan. 13, 1948)

Reference is made to U. S. Pat. 2,418,071 (Harris and Patterson) which has been abstracted in AMERICAN DYESTUFF REPORTER, p. 512 (1947). This patent related to reacting wool first with a solution of thioglycolic acid, in order to disrupt the cystine-linkages and then subjecting the fibers to the action of an alkyl halide, for instance, methyl iodide, in order to change the sulfhydryl group .. SH .. in a thioether group, for instance .. S.CH_3. This patent (U. S. Pat. 2,418,071) was a continuation-in-part of an application, filed May 20, 1940, and apparently not yet matured in a patent. But the present patent, filed under the name of Milton Harris is similar in many respects to Harris' and Patterson's patent quoted here above. According to the Patterson-Harris patent the reaction can be expressed schematically by the single steps (X and X′ .. = wool chain residues):

$$X-(S\text{-}S)_n-X' \longrightarrow X(\text{-}S\underset{H}{|}\quad S\text{-})_n X' \longrightarrow X(S\underset{CH_3}{|}\quad S)_n X'$$

In the present patent U. S. Pat. 2,434,-562) the alkylation (or aralkylation) is performed by applying *di*-chlorides or even compounds having more than two halogens. In one of the examples the wool fiber is treated as before with thioglycolic acid to give the structure $X(\text{-}S\quad S\text{-})X'$ (H H) but the further operation is different from that protected by the Harris-Patterson patent by the reaction with an alkyl bearing *halogen on both ends;* thus the equation runs for instance as follows:

$$\underbrace{X\text{-}SH \quad SH\text{-}X'}_{} + Br-CH_2-CH_2-CH_2\text{-}BR \longrightarrow XS\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}SX' + 2\,HBr$$

(when trimethylene bromide is used as a reagent).

This part is essential for the result obtained by the present process: U. S. Pat. 2,418,071 comprises disrupting the -S-S- linkages and etherifying each one of the thus obtained sulfhydryl groups with one alkyl. Therefore the former linkage between the two groups X and X′ has not been re-established in the alkylating reaction. According to U. S. Pat. 2,434,562, discussed here, however the two (or more) halogens linked to one alkyl group have the effect of reacting *with both sulfhydryl groups at the same time.* In this modified wool molecule the former connection is restored by an alkyl chain the length of which can be selected according to the properties desired in the final product.

References cited by the Patent Office are amongst others:

U. S. Pat. 2,261,094 (Speakman): The patent describes a treatment of keratin structures, especially by hair, by disrupting the -S-S- linkages in reacting the material first with a bisulfite solution and thereupon with a metal salt to obtain bonds of the formula:—S-Ba-S or -S-Ca-S-.

U. S. Pat. 2,253,102 (Du Pont-Walker): Wool is made shrinkproof by a treatment with dichlorodimethylether or similar halomethylethers. No theory has been advanced on this reaction.

U. S. Pat. 2,238,672 (Du Pont-Arthur): Wool is treated with a thiol compound (the SH- group is attached to a carbon atom). An example is cyclohexanethiol dissolved in an alkaline organic solvent (about 0.5% alcoholic sodium hydroxide solution).

Block Printing Device—Mechanically Operated D, 4

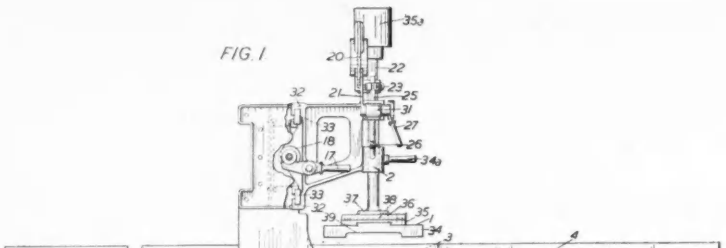
U. S. Pat. 2,432,364

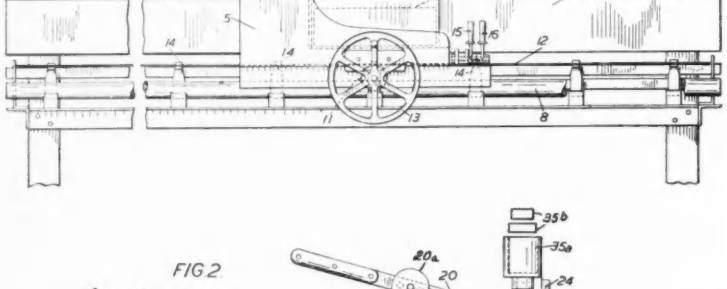
(David Evans & Co., Ltd., Wykes, Dec. 9, 1947)

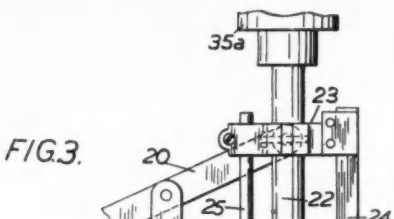
The art of block printing by hand depends on the individual skill of the operator. It is quite generally very difficult to carry out the procedures of dipping the block in the printing paste, transferring it to the cloth and printing it with exactly the same impact so that even results are obtained throughout a whole piece of fabric. Despite the small output produced in block printing however this art is preferred for special fine work. The apparatus protected by the present patent has the purpose of enabling less skilled or non-skilled workers to produce satisfactory prints. The blocks are fixed on the block holder (1), see Fig. 1, which is mounted in the carrier (2). This part of the construction can still better be seen from the detail in Fig. 3. The carrier (2) slides over the table (4) upon rollers or it is guided by a rail. It can be moved by a pulley (11) and cable (12) alongside the printing table. A series of fixed projections (14) are provided for locating the carrier in definite positions all over the table. These projections (14) engage with levers (15, 16). A similar device fixes the carrier laterally. The block is raised by a lever (20). Another lever (27) has the purpose of holding the block locked in a position above the cloth or letting it drop from a constant height. In order to supply the necessary printing paste to cover the block a tub (3) is provided which is placed beside the printing table. The carrier can be moved as shown in Fig. 2 over the tub (3) where it obtains, after every printing operation, some new printing paste. The upper end of the shank (22) connected with the block, forms a kind of cup in which some weights of different size may be placed to increase the impact of the block in the desired degree. It can be seen from this description as well as from the drawings that every movement can be carried out in a pre-determined amount. The impact may be varied by placing different weights in the cup mentioned above or by varying the height of the fall of the block. To obtain uniform results in printing a fabric the operator has just to handle accurately the levers for raising and lowering the printing blocks and for adjusting the carrier to the next printing position by using the projectors (14).

Earlier work done in this field:

It is interesting to note that (as far ar it can be seen from literature references) no attempt has been made up to now to mechanize the art of block print-







Block Printing Device
U. S. Pat. 432,264

ing. Equipment, partly similar to those described here above, has been suggested in the past in the art of screen printing. Reference is made for instance to the devices described in French patents 813,307 and 815,252 (K.L.V.) where the screen printing frames are moved alongside the printing table by a pulley; the movement is stopped by projections fixed in regular distance on the printing table.

ABSTRACTS

Textile Testing in Germany Part II. Serviceability Evaluation of Textiles

Herbert F. Schiefer, Lyman Fourt and Richard T. Kropf, Textile Research Journal, page 18, Vol. XVIII, No. 1, January, 1948.

Considerable research was carried on in Germany during the war to develop instruments and methods for determining and evaluating the serviceability and resistance to wear of textiles.

This paper presents a resume of the various researches made by different groups in Germany and contains not only test procedures for evaluating serviceability but includes detailed descriptions of the equipment used as well as photographs and explanatory schematic drawings.

A bibliography of the more important papers on wear and evaluation of serviceability of textiles is appended.

A Few Experiments on the Crystallinity of Polyamides

M. E. Bergmann, I. Fankuchen and H. Mark, Textile Research Journal, page 1, Vol. XVIII, No. 1, January, 1948.

This paper describes experiments performed on nylon samples which were treated with a dilute aqueous phenol solution to cause swelling and subsequently a high degree of crystallinity.

Previous work has indicated that as a result of inhibiting crystallization, rubbery materials having a high extensibility and low modulus are produced while increasing crystallinity results in a higher modulus and lower extensibility.

Using commercial 6, 6-nylon in the form of undrawn monofils and multifilament yarn, changes in crystallinity and orientation as a result of treatment were examined by means of x-ray diffraction diagrams. The mechanical properties of the nylon were investigated by cold drawing under controlled conditions.

Several x-ray diffraction diagrams are reproduced and discussed in the paper while the mechanical properties are presented by means of load-elongation curves.

Damages to Engraved Copper Rolls in Textile Printing

Canadian Textile Journal, page 48, Vol. LXV, No. 10, May 14, 1948.

Damage to the surface of the engraved copper rollers is perhaps one of the most common causes for unsatisfactory textile prints. This article shows how some of these damages occur and gives suggestions for their cure or prevention. Among the subject discussed are: roller surface cuts, effect of sand, filings, dust, etc., doctor streaks, effect of scums, badly prepared print pastes, fluff and lint, improperly

set doctor blades, imperfect roller surfaces, and careless drying of rollers.

Second Report of Fastness Tests Committee

Journal of the Society of Dyers and Colourists, page 133, Vol. 64, No. 4, April, 1948.

Tests to determine the fastness properties of colored materials to the following agencies are given:

I. Colored Materials of Natural or Renegated Cellulose

Acid Spotting	Hypochlorite in Bleaching
Alkali Spotting	Mercerizing
Burnt Gas Fumes	Organic Solvents
Cellulose Ester Bonding	Peroxide Bleaching
Cross Dyeing	Perspiration
Hot Pressing	Rubbing
Sea Water	Soda Boiling
Washing	Water

Water Spotting

II. Colored Wool Materials

Acid Milling	Peroxide Bleaching
Carbonizing	Potting
Chrome in Dyebath	Sea Water
Decatizing	Washing
Alkaline Milling	Organic Solvents
Chlorination	Perspiration
Cross Dyeing	Rubbing
Hot Pressing	Stoving
Metal in Dyebath	Water

III. Colored Acetate Rayon Materials

Acid Spotting	Cross Dyeing
Burnt Gas Fumes	Hypochlorite in Bleaching
Hot Pressing	Peroxide Bleaching
Organic Solvents	Rubbing
Perspiration	Steaming
Sea Water	Washing
Storage	Water Spotting
Water	

Alkali Spotting

IV. Colored Silk Materials

Acid Spotting	Alkaline Milling
Cross Dyeing	Degumming
Hot Pressing	Organic Solvents
Peroxide Bleaching	Perspiration
Rubbing	Sea Water
Washing	Water

Water Spotting

There is also included a description of the wash wheel, apparatus for testing fastness to burnt gas fumes and the grey scale.

Second Report of the Committee Appointed by Council to Discuss the Dyeing Properties of Direct Cotton Dyes

Journal of the Society of Dyers and Colourists, page 145, Vol. 64, No. 4, April, 1948.

Experimental work on cellulose fibers, other than cotton, has indicated that the tests, as designed for cotton, may be applicable to other cellulosic fibers. Accordingly, the classification of direct cotton dyes as originally proposed for cotton may be regarded as applicable to viscose rayon, Bemberg rayon, mercerized cotton, and linen. Small differences in the migration and salt controllability properties were noted between some of the fibers and cotton, but the order in which dyes are placed is the same on all the fibers. The first report of this committee was published in the *Journal of the Society of Dyers and Colourists* in September, 1946.

Shrinkproofing, Dyeing and Finishing Men's Hosiery of Wool and Nylon Blends

V. T. Hartquist, Textile Age, page 7, Vol. 12, No. 4, April, 1948.

The effort of giving shrink resistance to wool and blending it with other fibers which supplement both resistance to shrinkage and abrasion has occupied the dyer and finisher of men's hosiery. The chlorination processes for treating wool to produce shrink-resistance are discussed in considerable detail. The dangers in uncontrolled chlorination are pointed out. The effects of the wool stock and the stitch on shrink-resistance are also noted. In the chlorination of wool mixed with other fibers, the percentage of chlorine should be based on the wool content rather than the total weight of the batch. The most serious objection or fault in chlorination is the possibility of lowering tensile strength and abrasion resistance.

The dyeing of chlorinated wool should present no greater or newer problems than normal wool hosiery. Acid chlorinations must be thoroughly and evenly neutralized if dyed with milling or chrome colors. The affinity of all treated wool has been increased. A method for determining the migration properties of wool colors is given.

Considerable information on the dyeing and finishing of nylon-wool blends is given.

Textile Research Achievements in 1947

Julius B. Goldberg, Papers of the American Association of Textile Technologists, page 85, Vol. 3, No. 2, March, 1948.

It is pointed out that during 1947 more than 150 announcements of new or improved products, processes and equipment were published, matched by about an equal number of patents issued on items directly associated with the textile industry. The achievements, as discussed in this review, are classed under the following categories: (1) new fibers and rayons; (2) manufacturing methods and equipment; (3) dyeing and finishing products and operations, and (4) laboratory instruments and techniques.

Elements of Dyehouse Control

E. A. Leonard, Textile Age, page 7, Vol. 12, No. 5, May, 1948.

This article presents an outline of the materials, dyeing and color control system practiced at the Alexander Smith & Sons Carpet Company. The subject is discussed according to the following scheme: (1) Control of the incoming materials, among which are the dyes, chemicals (including salts, acids), and fibers in any form; (2) Control of the dyeing process: the technical phase, including time, temperature, acidity, levelness and exhaust; (3) Control of color: ability to manipulate the process to get the desired result.

Effect of Light Exposure on Animal Fibers

Arthur N. Patterson, Rayon Textile Monthly, page 97, Vol. XXIX, No. 4, April, 1948.

The selection of dyestuffs and the use of leveling agents to modify tippy wool dyeing are discussed.

Screen Printing

U. S. Testing Company Mill Notes, page 1, March 15, 1948.

Screen printing as compared to roller printing flourishes because the initial set up cost is less, it is better suited to handle prints of a variety of color and design in limited yardage, and screens of practically any size can be prepared cheaply so that large repeats may be produced. A description of the method of preparing the screen and making the prints is given.

Rayon Economies with a Synthetic Detergent

O. M. Morgan, Rayon Textile Monthly, page 95, Vol. XXIX, No. 4, April, 1948.

The use of a synthetic detergent in viscose spinning baths, desizing and scouring of rayon fabrics, saponification of acetate rayon, scouring rayon blends and dyeing of rayon and rayon blends is discussed.

The Definition of Rayon[1]

FOR centuries man has availed himself of a variety of natural fibers including cotton, wool, linen, silk, sisal and others, each of which is known by a generic name that connotes certain well-known properties or characteristics. Starting around the turn of this century man began to produce a variety of fibers based on various chemical materials particularly cellulose and proteins and later polyamides, vinyl compounds and other materials.

It is at once apparent that it is desirable to have a simple family name for the latter group of fibers comparable with the word "natural" as used in the phrase "natural fibers", and the words artificial, man-made, and synthetic have been used. It is agreed that artificial has an undesirable connotation and that synthetic is not strictly correct when applied to polymer molecules like cellulose or proteins which have been synthesized by nature and some have objected to "man-made" as being clumsy. The latter point of view is, of course, a matter of opinion.

It is a fact, however, that for business, scientific and statistical purposes a single family name is desirable and the problem under consideration is the choice of a suitable term. It obviously can be either of the three more or less appropriate words mentioned above or some new coined term or, as a much less desirable third choice, some word already in use with a somewhat different established meaning can be drafted to fill the breach.

The objections to the term "man-made" are relatively unimportant and in the United States it has been favored over coined terms in recent discussions. A year or two ago, however, the British Definitions Committee proposed that the word "rayon", be used as a family name for all man-made fibers and there are serious objections to this which we propose to discuss in further detail.

The word "rayon" was first promulgated in April 1924 by a committee sponsored by the National Retail Dry Goods Association, the Silk Association of America and the group which at that time were known as producers of artificial silk. The latter used the viscose, nitrate, cuprammonium and acetate processes for making fibers from cellulose. It should be noted that this committee was dealing with cellulose products every day and there were no other artificial silks available in commercial quantitives at that time. A review of the recorded minutes of the meetings shows no reference to fibers made from any other base than cellulose. This thought is confirmed today by men who were associated with the original committee in 1924. It is, accordingly, entirely unjustified to assume that the committee who coined the word "rayon" intended it to cover other fibers than those made from cellulose.

This feeling is supported by the publication in 1926 by the American Society for Testing Materials of the first official definition for rayon. Standard D 258-26 T includes the following definition, "1. (a) *Rayon* (formerly known as artificial silk). A generic term for filaments made from various solutions of modified cellulose by pressing or drawing the cellulose solution through an orifice, and solidifying it in the form of a filament, or filaments, by means of some precipitating medium."

Prior to publication this standard was approved by representatives of the trade, including producers, consumers and general interests.* It definitely limits the meaning of the word "rayon" to cellulose base fibers and has been repeatedly confirmed through the years since it was first published. At no time has it been suggested in the United States that rayon referred to fibers made from materials other than cellulose.

The Federal Tariff Commission (U. S.) in 1930 and the Federal Trade Commission in 1937 and again in 1941 used essentially the same definition and no one has questioned the fact that rayon meant a fiber derived from cellulose and having a certain well known typical range of properties.

This concept of the word rayon has been officially endorsed in Canada and the Union of South Africa in the last two years. It has also been accepted in Brazil.

It has been stated that when fibers made from non cellulosic materials such as gelatin, casein, real silk, milk, ossein, fibroin, albumin, alginic acid and polyvinyl compounds came on the market it was the practice to call them artificial silk.† To what extent such fibers were offered to the trade under the general designation of artificial silk in England is not known to the writers but it is definitely not true of conditions in the United States. Protein-base fibers never had specially silk like characteristics. They were never called artificial silk and their makers took considerable pains to set up a generic term for their product in order to distinguish it from rayon and the terms prolon, protan and finally azlon were considered. The latter was adopted officially for this purpose and first appeared in A.S.T.M. Standard D 123-46 T.

Similarly, vinyl-base fibers were marketed in the United States as Vinyon or Saran. They were never classed as artificial silks nor as rayon. This is equally true of nylon first offered for public sale in 1939. It follows, from the above record, that it is definitely incorrect to suggest or infer that the term "rayon" has been restricted to cellulose base fibers, only after the other man-made fibers appeared commercially in the period beginning around 1937.

More recently the properties which are connoted by the term "rayon" have become even more closely associated in the United States with the characteristics of regenerated cellulose and there is a definite feeling that cellulose acetate fibers having somewhat different dyeing and laundering properties should be designated by some other term.

Following the adoption of the word rayon in the United States in 1924, the Silk Association of Britain endorsed its adoption in Britain as a substitute for artificial silk although their official announcement did not specify what range of fibers was covered. In a sense this was a unilateral decision which was not supported by any industry-wide group comparable with the A.S.T.M. at that time. It has not yet been accepted by the British Government in its Customs and Excise regulations for example. Whatever the reason, it is a fact that the word "rayon" was not used in England extensively for many years and until quite recently the terms artificial silk and its corruption

[1] The following discussion of the definition of rayon is a reply to "The case for Rayon" as published by the British Definitions Committee in the Journal of the Textile Institute, *38*, Pages 627-628, December, 1947. It has been prepared by the officers of A.S.T.M. D-13, Sub-committee B-2 on Definitions and Nomenclature.

* Textile World, Oct. 10, 1925.

† Jour. Text. Inst. *38*, Pages 627-628, December 1947.

"art. silk" continued to be frequently used. The word "artificial" is still used by the authoritative Journal of the Textile Institute to classify abstracts dealing with man-made fibers. There is no body of evidence to show that contributors to the textile literature used rayon in a broad sense and it is only since the proposal was first made by the British definitions committee that such hybrid terms as "alginate rayon" and "protein rayon" began to appear in the literature. So far we have not noticed the use of the phrase, "nylon rayon" or "glass rayon" nor many advertisements that indicate the British producers of man-made fibers are in favor of this proposal.

The family of man-made textile fibers while having many textile properties in common already includes several genera having distinctly different characteristics and other fiber types will undoubtedly be produced in the future. The properties of some of the genera overlap but this condition and the problems of classification and analysis that go with it will not be affected appreciably by the particular word or phrase used as the family name for all man-made fibers unless the word chosen for the family has generic connotations. In this case distinction between the genera will be difficult.

It is questionable whether under any circumstances it is proper to borrow a word from its originators after its use and meaning have become well established and deliberately seek to give it a modified meaning as a matter of convenience. Considered from this point of view the proposals made by the British definitions committee are wholly unwarranted. Their proposal with respect to the word "rayon" is directly analagous to the suggestion that in the future we should use the word "wool" to cover all fibers from natural sources, or to cover all fibers in view of the use of the established terms "rock wool", "glass wool", "steel wool", etc. It should receive the same consideration.

Such a retrograde step is doubly confusing since the word "rayon" has filled a very definite need just as the generic terms cotton, wool or linen do. Any decision not to use them with their previous meanings would require some new terms to be coined to cover the same business, scientific and statistical uses as the familiar terms have covered in the past. Practically, this means educating the millions of people, who now associate rayon with certain specific properties derived from cellulose, to discard these ideas and remember that in the future the word rayon does not indicate any specific fiber properties. At the same time they must learn to substitute a new word in all the places where rayon has normally been used and associate the new name with the typical properties with which they are familiar. As pointed out elsewhere the trade will want a simple term, a single word if possible and it is reasonably certain that they will not be willing to use a complicated phrase such as "regenerated cellulose fibers made by the viscose, cuprammonium, and nitrate processes", all of which is now covered by the single word "rayon".

Such a proposal is not reasonable if there are other alternatives available and as, pointed out before, the latter are at hand. We can either use the phrase "man-made fibers" or coin a new term for this specific purpose. The fact that the word "rayon" already exists, or that it is euphonious, has no real bearing on this problem since it is not unique in these respects. Moreover it has not been proven that we need a euphonious term in any case. The success of the coined term "Kodak" suggests that euphony may be neither necessary or desirable.

A. G. Scroggie

F. D. Pilgrim

TRADE NOTES • NEW PRODUCTS

• Wetting Agent Pamphlet

E. F. Houghton & Co. of Philadelphia has issued a four page pamphlet on Cerfak 1300, a new concentrated liquid nonionic detergent and wetting agent.

The pamphlet is divided into five sections: 1. A description of Cerfak 1300; 2. A detergency chart giving readings of the detergency of the product in different concentrations, temperatures and water conditions; 3. A section devoted to the wetting out ability of Cerfak 1300 with accompanying Draves Tests chart; 4. Application of Cerfak 1300 throughout the entire textile industry and 5. A summary of the performance of Cerfak 1300 along with a list of other products designed for the textile industry by Houghton.

Cerfak 1300 is described in the pamphlet as a versatile, efficient and economical "across-the-board" synthetic surface active agent excellent for both wetting and scouring.

The pamphlet is available by writing to E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia, Pa.

• Rumford Appointment

Dr. Norman Oscar Stein, formerly General Superintendent of the Carbon Dioxide plants of Air Reduction Sales Company, New York, and wartime Manager of the Chemical Section, War Assets Corporation of Canada, who is now Chief Technical Assistant to the President of Rumford Chemical Works, Rumford, Rhode Island.

• New Test Fabrics Available

Testfabrics, 224 West 35th Street, New York 1, N. Y., announces the availability of Cotton Soil Test Cloth No. 26, prepared to Spec. 51S-47 (INT), Bureau of Ships. Also available are 5- and 10-gram skeins of viscose, acetate, nylon, Bemberg, wool, cotton and spun silk.

• Joins National Cotton Council

Challoner R. Chute has joined the technical service staff of the National Cotton Council of America. In his new position he will work in the field of technical surveys aimed at evaluating the present status of developments useful in improving the performance of cotton textile materials. After taking his degree in science at Cambridge University, Mr. Chute obtained extensive experience in the British, Indian, and Canadian textile industries before coming to America.

• New Office, World Chemical

World Chemical Corp. of New York City has announced that effective April 12th, their Export Division established new offices at 30 Vesey St., New York City. World Chemical Corp. are manufacturers of chemical specialties for the textile, leather and soap industries. Their Export Division also handles a complete line of industrial chemicals for these industries. Mr. M. A. Fischer will be manager of this office.

• DePaul Optical Bleaches

DePaul Chemical Company, Inc., 44-27 Purvis Street, Long Island City, N. Y., announces the development of a line of optical bleaches said to be highly efficient for use in the textile and paper industries. These compounds are substantive to textile fibers and exert a marked whitening effect upon them.

"Chemo-bleach P" and "Chemo-Bleach PG" have been developed for use on vegetable fibers and nylon. "Chemo-Bleach W" when used together with "Chemo-Bleach W Assist", is said to give a striking whitening effect on wool, eliminating the need for a bleaching operation.

These optical bleaches are applied to the cloth as dyes and, it is stated, have already met with considerable success in the textile industry. Full scale production of these compounds, for which a patent application has been filed, will begin in one month. Samples are now available for trial.

• LTI Commencement

Seventy-three degrees and diplomas were awarded by President Kenneth R. Fox of the Lowell Textile Institute at the 50th Commencement of the Institute, held Tuesday, June 1, at the Merrimack Square Theatre in Lowell.

The Commencement address was given by Joseph H. Axelrod, President of Crown Manufacturing Company, Airedale Worsted Company and Wamsutta Mills, who spoke to the largest graduating class in the Institute's history on the subject, "Modernization—the Hedge in Textiles." Mr. Axelrod started in the textile business 10 years ago with $500 and two employees. Today he controls seven mills valued at over $10,000,000 and has 3,000 employees.

The cotton medal of the National Association of Cotton Manufacturers, awarded to the graduate showing the greatest achievement in cotton manufacturing, was presented to Ray M. Spofford, Haverhill, by John Rogers Flather, Asst. Treasurer of the Boott Mills, on behalf of the N.A.C.M.

The Phi Psi fraternity award for the senior showing the most outstanding combination of leadership, personality and scholarship went to James H. Kennedy, III, of Lowell. The Dr. Louis A. Olney book prize for the highest standing in chemistry courses was won by James F. O'Donnell, North Chelmsford. John M. Roughan, Lowell, was the winner of the Textron Fellowship for one year's advanced study.

Organization of the senior class included: president, John M. Roughan; vice-president, Peter J. McKone, Jr.; secretary, Roger P. Farren; treasurer, Albert L. Bianco; marshal, Ray M. Spofford; class advisor, Prof. Charles F. Edlund.

Sixteen graduates were awarded the master of science degree, forty-three the bachelor of science degree and 14 diplomas in textile manufacturing. Graduates in textile chemistry and their degrees follow:

Master of Science in Textile Chemistry

Ramswarup G. Godiwala,
B.Sc., University of Bombay, 1943.
L.T.C., Victoria Jubilee Technical Institute 1945.
Bombay, India.

Rita P. Landry,
B.T.C., Lowell Textile Institute, 1946.
Lowell, Massachusetts.

Robert E. Willett,
B.S., North Carolina State College, 1938.
Alexandria, Virginia.

Henry K. Woo,
B.S., St. John's University, 1939.
Shanghai, China.

Yuan L. Yang,
M.S., St. John's University, 1945.
Shanghai, China.

Bachelor of Science in Textile Chemistry

John W. Bardzik,
Dracut, Massachusetts.

Jerome F. Bauer,
Waterloo, Ontario.

Albert L. Bianco,
East Paterson, New Jersey.

Wilfred L. Boule,
Lowell, Massachusetts.

Roger P. Farren,
Medford, Massachusetts.

Eleanor E. Foley,
Lowell, Massachusetts.

Allen M. Frank,
Lowell, Massachusetts.

Nathaniel H. Glade,
Lowell, Massachusetts.

John E. Hirn, Jr.,
East Hartford, Connecticut.

Albert G. Hoyle,
Lowell, Massachusetts.

Joseph V. Kopycinski,
Lowell, Massachusetts.

John T. McKniff,
Forge Village, Massachusetts.

Peter J. McKone, Jr.,
Lowell, Massachusetts.

Alan M. McNally,
Dracut, Massachusetts.

• Swift & Company Appointment

Carlyle G. Morton, who for the last twelve years has been engaged in research in the laundry and textile field, has been appointed head of the Laundry Research Division of the Swift & Company Research laboratories.

Mr. Morton formerly was manager of the certified Seal Laboratories of the American Institute of Laundering in Joliet, Illinois, and joined Swift & Company in October, 1947. His promotion to head of the laundry research division was announced by Dr. R. C. Newton, vice president of Swift, and H. S. Mitchell, Director of the Laboratories.

Function of the division Mr. Morton heads is to carry on research in laundry and textile practices and procedures and to test commercial soap and alkali products the company manufactures for many industries including the laundry and textile trade. Technical service also is available to all industrial soap accounts, including laundries, textile mills, rubber processors, wire mills, tanneries, soap converters, paper mills, hotels and institutions.

Mr. Morton is a member of the American Chemical Society and helped to organize and is past chairman of the Joliet Section; is a member of the American Association of Textile Chemists and Colorists, and has served on several committees of the American Standards Association.

Robert B. **Meister,**
Maynard, Massachusetts.
Gerard C. Morel,
Andover, Massachusetts.
Edward D. Wielicka,
Lawrence, Massachusetts.
George C. Murphy,
Buffalo, New York.
Chung-sheng Na
Kunming, China.
James F. O'Donnell,
N. Chelmsford, Massachusetts.
James M. O'Flahavan,
Lowell, Massachusetts.
Stuart E. Penner,
Lawrence, New York.
James M. Reynolds,
Lowell, Massachusetts.
John M. Roughan,
Lowell, Massachusetts.
Richard B. Simon,
New York, N. Y.
Edward D. Wielicka,
Lawrence, Massachusetts.

• Chemical Formulary

Volume VIII of The Chemical Formulary, edited by H. Bennett, has just been published by The Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y.

• Joins Synthron

Synthron, Inc. of Ashton, Rhode Island, manufacturing chemists for the textile industry, announces the appointment of Leon Tigler as their sales representative in the Carolinas.

Mr. Tigler was formerly employed by Ciba Co., Inc. He holds a B. S. Degree in Textile Chemistry from Clemson College.

Mr. Tigler is a member of the AATCC and Phi Psi Fraternity. During the war, he served as an Infantry officer in the European Theater.

• Dr. Sachs Retires

Dr. John H. Sachs, manager of the Development Division of Du Pont's Organic Chemicals Department, retired from the company on May 31st.

Dr. Sachs' career with Du Pont parallels the development of America's dye industry, with which he has been prominently associated for 31 years. In the summer of 1919, the company announced the first American production of anthraquinone vat dyes—a development in which Dr. Sachs actively participated—and in 1920 started the manufacture of another major type, the thio-indigoid colors. Dr. Sachs played a leading role in the development of dyes and dye intermediates with particular reference to the synthesis of anthraquinone vat dyes, on which he is a recognized authority.

During Dr. Sachs' 31 years with the Du Pont Company, he has had many patents granted on his inventions in the chemical field, and has written numerous articles for scientific publications. He has recently completed two articles for a revision of the Encyclopædia Britannica now in preparation, one on anthraquinone and the other a 22,000-word article on synthetic dyes.

He was born on April 14, 1889. He received his bachelor of science degree from Gettysburg College in 1910, and his Ph.D. from The Johns Hopkins University in 1916. He was a Carnegie Fellow at Johns Hopkins 1916-1917.

Dr. Sachs joined Du Pont as a research chemist at the Experimental Station in Wilmington in June, 1917. A year later, he became a division head at the Jackson Laboratory at Deepwater Point, N. J. In January, 1920, he was named superintendent of anthraquinone colors production at the Dye Works—now the Chambers Works—at Deepwater Point, N. J. He became general superintendent of anthraquinone and sulfur colors production in January, 1929. He returned to Wilmington in January, 1933, as special assistant to the manager of the Dyestuffs Division, becoming manager of the Development Division of the Organic Chemicals Department in June, 1943.

• Althouse Honored by Dickinson

C. Scott Althouse, owner of the Althouse Chemical Company, Inc., Reading, Pa., was awarded an honorary doctor of science degree at the 175th commencement exercises of Dickinson College, Carlisle, Pa. The following citation was recorded:

"You have been largely instrumental in the invention and development of many of the industrial processes connected with textiles. Shortly after your graduation from the Philadelphia Textile Institute, you discovered what has become the standard process for making wool unshrinkable.

"Your inventions cover nearly the entire range of the textile industry, including dyeing and printing machines, dyes, dyestuffs and dyeing processes. You developed multi-colored dyeing in a single operation and new ranges of light-fast color dyes.

"You were one of the pioneers in the development of the processes by which rayon is manufactured. Dickinson College recognizes you for these accomplishments, which have added richness and variety to the American way of life."

Dr. Althouse was also elected a trustee for a three-year term of the Dickinson Law School at the annual meeting of the school's board of trustees.

Among the others upon whom the college conferred honorary degrees were Fred M. Vinson, Chief Justice of the U. S. Supreme Court and the Rev. Dr. Harry Emerson Fosdick, pastor of the Riverside Church, New York City.

Mr. Althouse is a member of the American Association of Textile Chemists and Colorists.

• Report on Consumption of Fibers

The Southern Regional Research Laboratory, U. S. Department of Agriculture, New Orleans 19, Louisiana, announces publication of a report entitled "Trends in the Consumption of Fibers in the United States, 1892-1946." This report is intended to serve as a source of basic data on consumption of fibers in this country and gives statistics on the basis both of quantities used by mills and quantities used by ultimate consumers, An addendum also gives 1947 data. Copies are available without charge from the Laboratory.

• Tennessee Eastman Representative

Tennessee Eastman Corporation, Kingsport, Tennessee, announces the appointment of a Chicago representative to solicit sales of its chemicals. The new representative, R. H. Cannon, Jr., has opened his office at 360 North Michigan Avenue, Chicago, Illinois.

In 1946 a branch chemical sales office was inaugurated in New York City to

serve the Eastern and New England territories. Increased sales representation has been necessitated by the addition, since V-J Day, of several new derivatives of hydroquinone, dye intermediates, and lacquer solvents to the list of organic chemicals already manufactured by the corporation. An extensive sales campaign has aroused considerable interest in these chemicals, and production has been greatly expanded at the Tennessee Eastman plant.

Mr. Cannon has been associated with the chemical sales activities of Tennessee Eastman Corporation since February, 1947. He is a graduate of the University of Alabama School of Chemical Engineering, from which he holds a Master's Degree.

• General Aniline Slogan

"From Research to Reality" is the winning entry in a slogan contest at General Aniline & Film Corporation, Jack Frye, President, announced recently. For "originality and aptness and because it suggests the high quality of General Aniline products, its ranking position in the chemical industry and the importance of research in that field," this slogan, submitted by Stanley W. Ulkloss of 608 Gordon Street, Haddon Heights, New Jersey, was awarded first prize of $500 by contest judges John Kieran of radio's "Information Please," Dr. Ralph Cooper Hutchison, President of Lafayette College and Harold Sidney Ward, Vice President of Young & Rubicam, Inc., advertising agency.

3,841 entries were submitted by employees seeking a share in the $1,000 slogan prize fund.

Second prize went to Arnold T. Hofmann of the Ansco film and camera division of General Aniline at Binghamton, New York, for his entry "Research—Service—Progress," and third prize was won by Reginald J. Rodil of Newark, New Jersey who is employed in the dyestuffs division at Grasselli, New Jersey.

• New Launder-Ometers

The Atlas Electric Devices Co., 361 W. Superior St., Chicago, has announced the development of two new Launder-Ometer models. The large capacity of these new machines is said to make them ideal for laboratory research in testing color-fastness of dyestuffs and launderability of materials.

Model L1Q has a capacity of 20 pint or 20 quart jars; Model L2Q will accommodate 20 pint, 20 quart or 6 half-gallon jars. Both units are available with vari-speed drive unit for operation between 10 and 50 r.p.m.

New Launder-Ometer

• Du Pont Price Increases

The Du Pont Company announced on June 10th increases of 5 to 10 per cent on selected items of dyestuffs where the company said the action was made necessary by increased production costs on those items.

The company said that on more than a majority of the hundreds of dyestuffs items it produces, it is making no increase even though production costs have also increased on these. The increases, effective July 1, will raise the average for the entire line by less than 4 per cent.

The present average of Du Pont dyestuffs prices has been held to approximately 18 per cent above the 1939 level, despite increases several times as great in the cost of labor, raw materials and other manufacturing expenses, and compared with an increase of 113 per cent in the national average of wholesale prices in the same period.

• Rohm & Haas Appointment

The Rohm & Haas Company of Canada, Ltd., has announced the appointment of Herbert Eastwood as Canadian Textile Chemicals representative.

Mr. Eastwood has been connected with the textile industry in Canada for nearly twenty years. He comes to Rohm & Haas from the Canadian Industries Ltd., where he was assistant district sales manager of the chemical group for Ontario. Preceding this he was with the Robinson Cotton Mills, Ltd., Woodbridge, Ontario, and the Wabasso Cotton Company, Ltd., Three Rivers, Quebec.

In preparation for his new duties, Mr. Eastwood will spend several months working in the Rohm & Haas Company's textile laboratory in Philadelphia to familiarize himself with the various products and their uses. He will also visit textile plants to observe the industry in the United States before returning to take up his new work in Canada.

• Reorganization at LTI

The establishment of a new Department of Social Sciences and the consolidation of the Department of Textile Chemistry and Coloring with the Department of Finishing were announced by President Kenneth R. Fox in a series of basic faculty re-organizations at Lowell Textile Institute.

The Department of Social Sciences, said President Fox, will include all courses in Psychology, Sociology, Labor Relations, Marketing, Economic Geography, and similar fields and has been created in recognition of the increasing importance of human relations in social and industrial activity. The emphasis of the new Department, further stated President Fox, will be on an effort to cut across traditional lines of thinking and teaching basic economic subjects, social sciences, and history and to integrate the fundamental ideas from each field into courses of modern significance and current application. It is expected that students will obtain a clearer picture of comparative governments, mass production, and its relation to the growth of American industry, profit motives, the rise of the labor movement and the current picture of labor-management inter-relationships, and other equally important concepts.

Consolidation of the Departments of Textile Chemistry and Finishing, continued the statement of President Fox, was brought about by the rapid changes in both fields and the mutual contribution of each field to the growth of textile finishing technology. The grouping of these two departments will permit a much more effective design of courses to insure the students a complete course in textile chemistry, properly oriented to the swift changes being made in the field and the elimination of separate courses in the chemistry and mechanics of finishing operations.

• President, New York Chapter, Alphi Chi Sigma

Dr. Clarence H. Buurman, a member of the professional staff at the General Aniline & Film Corporation's Linden plant, was elected president of the New York Professional Chapter of Alpha Chi Sigma, a national chemical fraternity, on May 12th. The New York chapter, with an active membership of about 350, is the largest professional unit of Alpha Chi Sigma in the United States.

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Harmony in wool . . . is how the Magee Carpet Company describes its product. In styling, colors and textures, Magee offers opportunities to build any choice of room decoration around the rug.

Because Magee promises "colors that blend with any scheme", the company insists upon the highest grade of dyestuffs — a fact which gives significance to their selection of Sandoz.

Among Sandoz colors that meet the highest standards for processing and service are

ALIZARINE LIGHT BLUE 4GL or 5GL and XYLENE LIGHT YELLOW 2G

the best combination for level dyeing and fastness to light in green shades.

Due to their reliability, the dyer can control his colors to match exact specifications . . . and due to their fastness to light and service, the customer can be sure of long-lasting beauty.

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POSITION WANTED: Cotton and rayon piece goods finishing control chemist with 23 years' experience. College graduate, able to assume charge of laboratory. Prefer location north of Virginia along seaboard. Write Box 349.

TEXTILE CHEMIST: Well established manufacturer NYC area seeking textile chemist with extensive knowledge and experience in manufacture and development of textile auxiliaries. Knowledge of dyeing and finishing preferable. Excellent prospects for right man. Write Box No. 420.

POSITION WANTED: Consulting chemist with over twenty years experience in development and production of resin emulsions, emulsion paint, wax emulsions, ethyl cellulose lacquer emulsions, asphalt emulsions, adhesives and specialty items is available for Consulting Service. Write Box No. 454.

POSITION WANTED: Textile chemist-colorist, 28, college graduate. Familiar with piece goods dyeing and finishing rayon, acetate, and mixtures; including continuously. Development and laboratory control. Write Box No. 457.

OPPORTUNITY FOR YOUNG CHEMIST, preferably Ph.D. with fundamental knowledge of textiles, for research on additive agents. Location northern New Jersey. Give education, experience, etc. Write Box No. 440.

POSITION WANTED: As hosiery dyer possessing laboratory research and color control. Seventeen years as head dyer for a large hosiery manufacturer in the South. Excellent references as to ability and character. Write Box No. 402.

TEXTILE COST ANALYST

Capable of calculating costs on yarns, fabrics and specialties. Prefer textile educational background, but would also consider accounting educational background with textile manufacturing experience. State qualifications and salary. Location: Rockefeller Center, N. Y. Write Box No. 464.

CONSULTANT WANTED: Chemical specialty manufacturer seeking to engage services of consultant with manufacturing knowledge of stiff, non-marking off finishes for nylon veilings. Write Box No. 462.

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The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery wanted or for sale—the rate is $7.50 per column inch or less per insertion.

POSITION WANTED: Textile chemist age 36, college graduate, 12 years research and control experience in all phases textile manufacture from raw material through dyeing and finishing. Also 3 years viscose rayon manufacturing. Technical sales and research or production desired. Philadelphia area preferred. Write Box No. 460.

WANTED DYER: One who has had experience in dyeing plied yarn fabrics. A person capable of co-operation and supervisory qualities is needed, in return we offer a lifetime opportunity. Plant is situated in Northern New Jersey and has a high degree of perfection. Write Box No. 461.

POSITION WANTED: New England preferred. Dyeing, printing and finishing superintendent seeks connection with reliable concern. 18 years experience in bleaching, dyeing and printing and finishing cotton and rayons. Textile School Graduate. Write Box No. 465.

CHEMIST WANTED: for laboratory research and development work on problems incident to a large, modern finishing and dyeing plant. Sound chemical background and practical experience in laboratory dyeing and matching of shades essential. Analytical experience desirable. Write Box No. 466.

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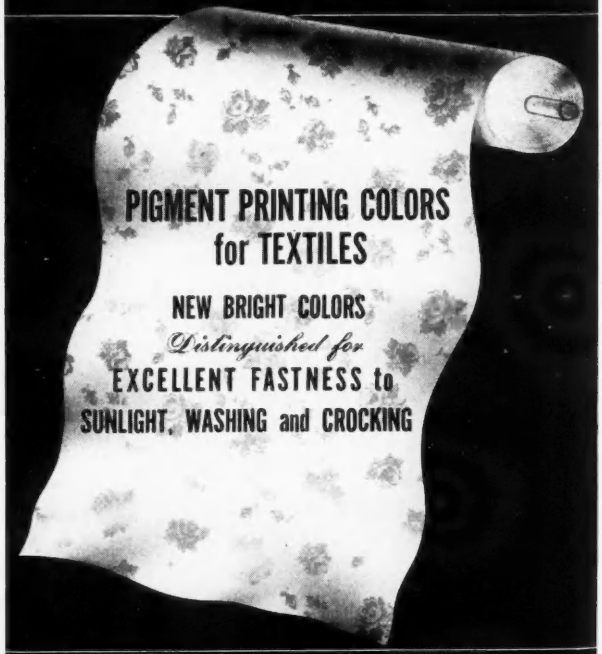

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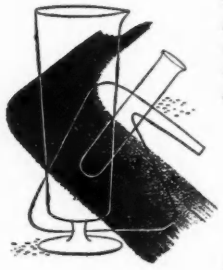

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***AQUAROL:** A water repellent for processing woolen, cotton and rayon fabrics, also produces excellent results in splashproofing or finishing all types of hosiery.

***PARAMINE T A:** A cation active softener for processing cotton and rayon cloth to obtain a soft, smooth, pleasing finish.

ANTHOMINE: Auxiliary used in all wool dyeing processes to produce a uniform shade and impart a soft pleasing hand to stock, yarn and cloth. Improves exhaustion of dye bath and increases color yield. Very effective for levelling shade of tippy and mixed wools.

***PARAPON S A:** A highly efficient leveler and softener for dyeing and finishing all types of yarn, cloth and hosiery to produce a uniform dyeing and a soft full hand.

***ARIPEL F S:** Finish and gas inhibitor for processing dyed acetate rayon—produces a soft, full feeling finish and prevents gas fading of the color.

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***ALGEPON V A:** Auxiliary used in dyeing vat colors to retard reoxidation of the reduced bath and produce a solid and uniform shade—also effective in stripping vat dyeings.

***CULOFIX:** Used as an after treatment in last rinse to prevent bleeding of direct dyed cotton or rayon in water.

***DIAZONOL A C:** For boiling out cotton cloth in pressure or open kiers to produce greater absorbency and cleaner material. Excellent for pre-boiling knitted cloth in preparation for chlorine bleach. Also used with good results for boiling out cotton or rayon cloth on the jig.

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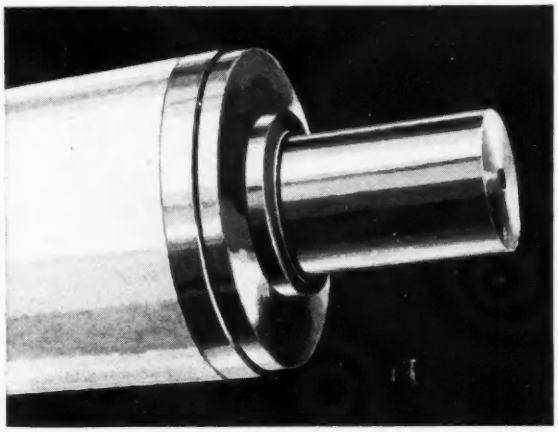

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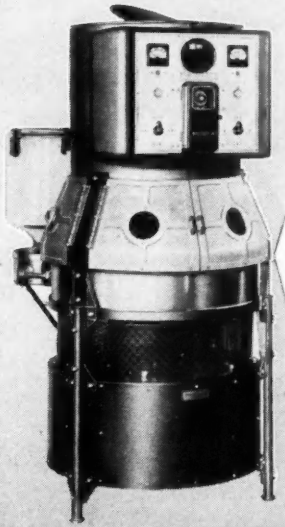

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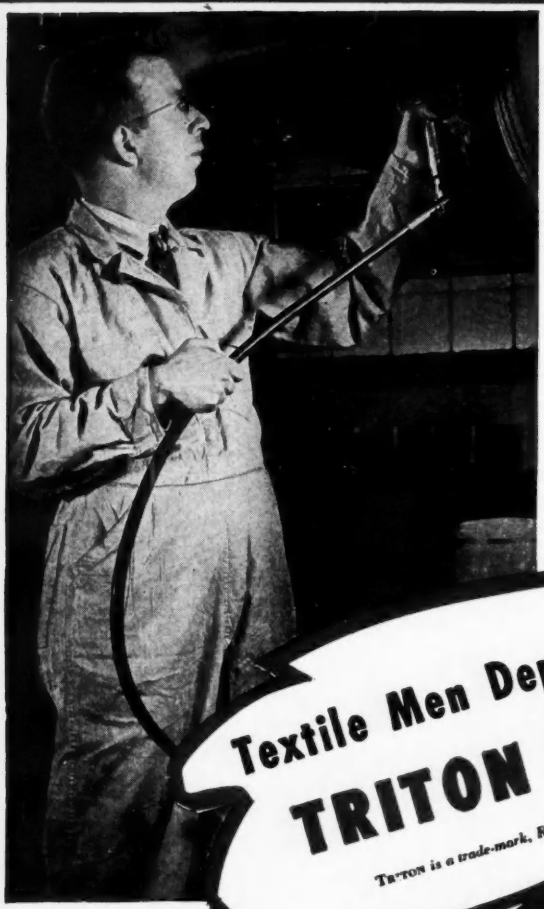

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